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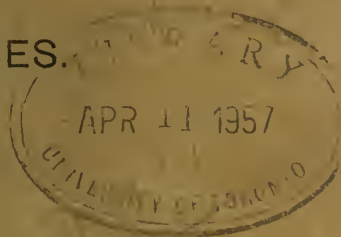
DEPARTMENT OF MINES AND AGRICULTURE

GEOLOGICAL SURVEY.

E. F. PITTMAN, A.R.S.M., Government Geologist.

MINERAL RESOURCES.

No. 8.



REPORT

ON THE

HILLGROVE GOLD-FIELD.

BY

E. C. ANDREWS, B.A.,

GEOLOGICAL SURVEYOR.

1900.

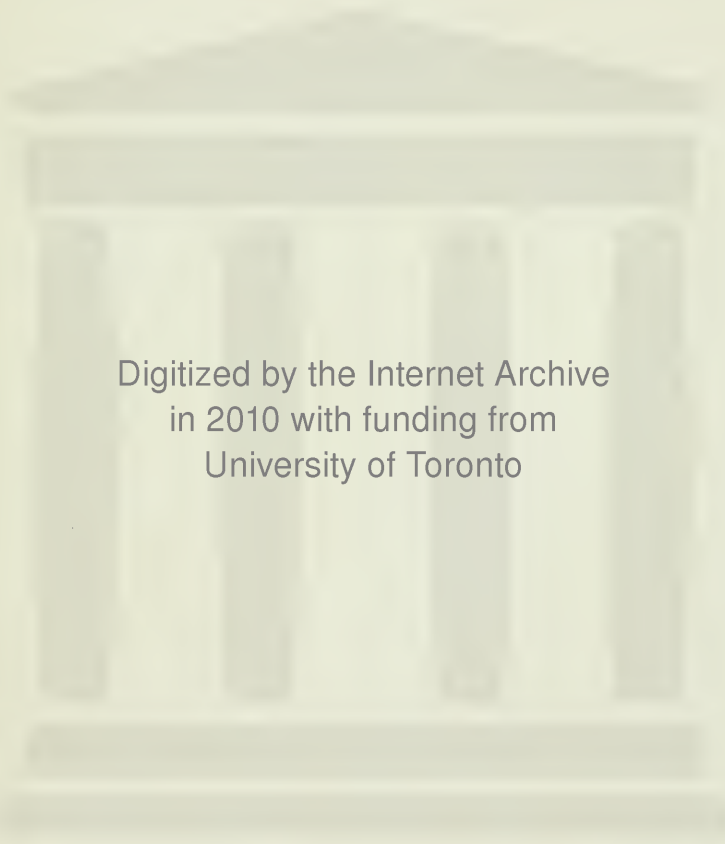


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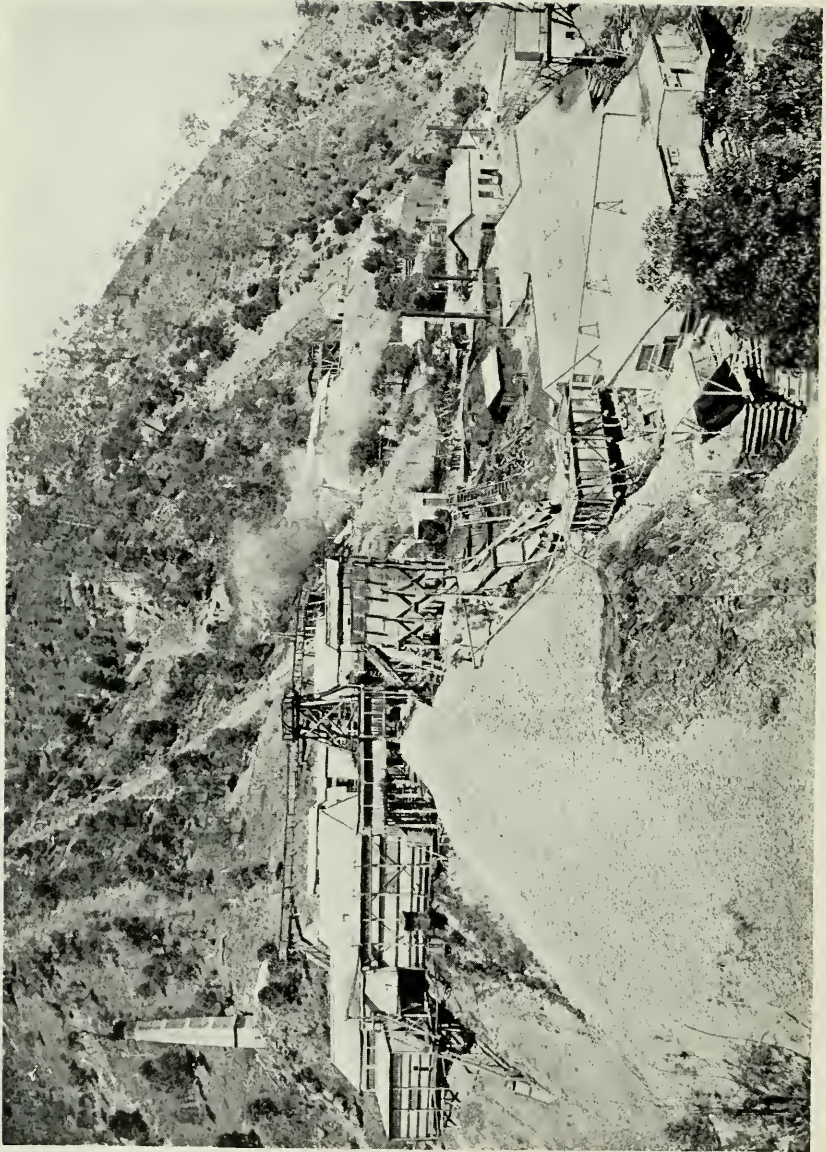
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BAKER'S CREEK BATTERY, FROM THE WEST.

NEW SOUTH WALES.

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LETTER OF TRANSMITTAL.

Geological Survey Branch, Department of Mines,

Sir,

Sydney, 4 June, 1900.

I have the honor to transmit for publication Report No. 8 of the Mineral Resources Series, on the Hillgrove Gold-field, by Mr. E. C. Andrews, B.A., Geological Surveyor.

The geological survey of a considerable portion of this field was made by Mr. J. A. Watt, late Geological Surveyor ; that gentleman, however, resigned his position on the staff at the end of March, 1899, and the survey has been completed by Mr. Andrews, who also examined the underground workings of the mines, and has furnished the accompanying report.

Hillgrove is one of the most important of the New South Wales gold-fields discovered in recent years, and it is of special interest on account of the occurrence there of lodes containing ores of both antimony and tungsten, associated with gold. The recovery of gold and antimony, from ores containing the two metals in conjunction, has always been a troublesome metallurgical problem, and in Hillgrove we have a field which offers a valuable opportunity to anyone who can devise a workable process for separating and saving the two metals. The scheelite deposits have recently been proved to be of considerable importance also, and it is hoped that the publication of this brochure may, by drawing the attention of the public to these interesting mineral deposits, have the effect of reviving the mining industry of the district.

I have, &c.,

EDWARD F. PITTMAN,

Government Geologist.

The Under Secretary for Mines.

SYNOPSIS OF CONTENTS.

1. INTRODUCTION.

2. HISTORY OF THE FIELD.

3. PREVIOUS LITERATURE DEALING WITH THE HILLGROVE AREA.

4. PHYSICAL GEOGRAPHY.

(*a*) Drainage system. (*b*) General appearance of tablelands. (*c*) Ravines. (*d*) Scenic features. (*e*) Meteorology. (*f*) Influence of the ravines on the mining industry.

5. GEOLOGY.

Various rocks of field. Chronological order of geological events. (*a*) Sedimentary rocks. (*b*) Eruptive rocks—First granite intrusion; second granite intrusion; third granite intrusion; fourth and latest acid intrusion; dykes; slopes of Hillgrove granite bosses. (*c*) Metamorphism—The sedimentary rocks; the “kicking” slate; the eruptive rocks. (*d*) The Lodes—Direction of strike; origin; later movements; cross courses; occurrence and nature of ores. (*e*) Geological events subsequent to the formation of lodes—Metamorphism; erosion of Palaeozoic rocks; old river beds; Tertiary basalts; erosion of rocks since Pliocene (?) times to form present ravines. (*f*) Petrological notes on some Hillgrove rocks.

6. LIFE OF THE REEFS AT THE LOWER LEVELS.

7. DESCRIPTIONS OF MINING PROPERTIES.

(*a*) The Golden Gate Reefs. (*b*) The Proprietary Reefs. (*c*) The Hopetoun Reefs. (*d*) The Eleanor Reef. (*e*) The Garibaldi Property. (*f*) The Cosmopolitan Reefs. (*g*) The Carrington Reefs. (*h*) The Sunlight Reef. (*i*) West Sunlight Mine. (*j*) Baker's Creek Reefs. (*k*) The Consols Reefs. (*l*) Starlight Reef. (*m*) Sandon Electric Light and Power Company. (*n*) Paradise and No. 9 Antimony Lodes. (*o*) Murgatroyd's Tunnel. (*p*) Minor Properties—The Baal Gammon Reef; Trimm's Tunnel; Mount Carrington Gold-mining Company; Beiber's Tunnel; Keye's Scheelite; Maddrick's Schelite; Brackin's Spur; Beck's Antimony Lode.

DESCRIPTION OF PLATES.

Report on the Hillgrove Goldfield.

INTRODUCTION.

THE immediate object of this report is to furnish a fairly clear conception of the field to the mining public by brief reference to the succinct points in the historical, topographical, geological, and economic mining features of the area under consideration. A map and sections of the field have been prepared. On the map are shown the relative extents of the various derivative and eruptive rocks of the Hillgrove area, as also the nature of their junctions one with the other. Thus the practical miner, knowing the Hillgrove area well, may take this as a guide wherewith to recognise similar rocks in contiguous areas. As an example, everyone using the Baker's Creek Tramline must have observed the great bluffs of rock and attendant long talus slopes exactly opposite to them in their progress downwards. With very few exceptions the miners of the field have assured me that it is a hardened slate, despite all assurances to the contrary. When it is known that this fine-grained rock is intrusive into the older rocks that contained the lodes, it is readily seen what a vanishing quantity the hope becomes of finding here the continuations of such reefs as the "Big" and "Little" lodes, which, however, would be quite feasible were the rock under consideration a belt of slate, as believed by the majority of men on the field.

The country is admittedly difficult to conduct geological observations in accurately. This is due in part to the highly metamorphosed character of many belts of the sedimentary formations, rendering it difficult to discriminate between fine-grained eruptive rocks and some of the more indurated and silicious slates. As an example may be quoted the curious belt of rocks running north and south through the Catholic School grounds, and ending southwards in a prominent bluff of rocks, overlooking for miles the valley of Baker's Creek, and known as Whittaker's Spur (Plate II). At first glance this might be mistaken for a granitic rock, although even a cursory inspection of its weathering reveals its sedimentary nature. Another and more difficult case occurs on the Metz side, on the flat ground west of Petersen's and Bewley's scheelite lodes. Here two long tongues of slate alternate with as many tongues of fine granite, and, to the untrained eye, the two are indistinguishable. Many have pronounced it all altered slate country. In reality, as seen on the map, the slate occupies the smaller area. Possibly the Four-mile offers the most bewildering spectacle, where granitic rocks in places succeed in palming themselves off as sandstones and slates, and altered bedded rocks conceal almost every trace of their derivative origin.

Special features of the report, exclusive of the main idea of the work, consist of notes on the numerous dykes which intersect the sedimentary formations ; the prevailing types of lode formations ; the antimony and scheelite lodes ; descriptions of the machinery ; and the methods of travelling on the steep hill sides.

As a starting point, and a basis of work, I had the partially completed map of Mr. J. A. Watt, M.A., B.Sc., formerly one of the Geological Surveyors in this Department. Having made use of his main east and west line of junction of the eruptive and sedimentary rocks, I preferred to undertake most of the work *de novo*, as it was necessary to get well acquainted with the surface before attempting the underground survey. With one or two exceptions, our boundary lines, &c., are fairly coincident. The various junctions of eruptive and sedimentary rocks to the east in the difficult country of the Four-mile Creek, and those also to the south of Bakers' Creek, were, previous to my reconnaissance, a blank page. For these I am alone responsible, as also for the squaring-up of the map in all directions. The broken character of the country, the veiling of the various lines of junction under masks of shingle, and the great metamorphism of the rocks, necessitated a far greater expenditure of time than would be required for the examination of ordinary country. Besides these, the absence of landmarks was felt, and some of the junctions are, at best, only approximately true. I was enabled to secure a fairly good series of photographic negatives, dealing with subjects of mining and geological interest. In all departments of the work I have to acknowledge the great assistance of Mr. M. Morrison, Field Assistant, who accompanied me throughout the trip. Especially valuable was his aid in dealing with the difficulties that beset us in attempting to make out the chronological succession of the eruptive rocks.

I desire to here cordially thank Mr. G. Smith, one of the directors of Baker's Creek Gold-mining Co., Mr. Thomas and Mr. M'Namara, of the West Sunlight Mine, for notes on the general history of the field ; Mr. H. M. Porter, Manager of the Proprietary Mine ; Mr. S. McGeorge, Manager for Baker's Creek Gold-mining Co. ; Mr. R. Sharp, Manager of the Eleanora Mine ; Mr. F. Cape, Manager of the Sunlight Mine ; Mr. S. Mills, Manager of the Consols Mine ; Mr. T. Snow, of the Golden Gate Mine ; Mr. A. Nicholson, of the Starlight Mine ; Mr. J. Fuller and Mr. S. Sullings, for permission to make tracings of their mine plans, for information concerning the gold yields of their respective claims, and for notes on the history of their respective mining properties ; also, all the underground managers and other officials, from whom, without exception, I received every assistance in the way of mine measurements, and other items of interest in the underground workings.

2. HISTORY OF THE FIELD.

Three decades ago the population of Hillgrove was confined to a few stragglers on the Metz side, who divided their time between helping at the local station during the shearing season and occasional prospecting along Baker's Creek bed. That was before the discovery of gold and antimony in payable quantities. To-day some 3,000 people draw their means of livelihood, directly or indirectly, from the product of the reefs ; and Wyalong, a field of still later growth, is to-day the only field in New South Wales ahead of it in gold returns ; while so far is the latest report of Baker's Creek Co. from sounding a note of decadence, that the final fortnightly clean-up for the half-year totalled 1,285 oz. of smelted gold.



To face page 6.

WHITTAKER'S SPUR, SEEN FROM THE SOUTH.

At first all the difficulties attendant on pioneer mining in broken country had to be encountered; horses, bullocks, and men dragged loads of ore while they climbed the steep sidelings—so steep sometimes that bullocks have been dragged back by their loads; landslips were common in the treacherous ground at Swamp Creek; dollies were the only appliances available for extracting the gold; and after tremendous expenditure of energy in hauling the ore up the gorge slopes, long monotonous journeys had to be undertaken by teamsters over execrable roads to Grafton or Tamworth before their loads could be delivered over to steamers or trains. Batteries and good tracks came slowly at first, but with the advent of payable ore conditions were altered. Tramways were constructed on the hill sides, large batteries were erected to facilitate crushing operations, and at the present time the Sandon Electric Light and Power Co. are preparing to drive the machinery and light the mines by electricity.

Having thus glanced generally at the history of the field, it is proposed to note briefly the chronological order of the more important events constituting the principal factors in the making of the Hillgrove of to-day.

Havershed Bros. and Thomas led the way in 1877 by finding an antimony lode quite close to, and south of, the present Hopetoun Reefs. A parcel of 4 tons 17 cwt. was obtained by them from the outcrop, carted to Grafton, and thence despatched to England; £17 15s. was paid for the consignment. Negotiations were then entered into by this party with Hudson and Co., of Sydney, for the purpose of erecting antimony smelting works.

About the same time Campbell Bros. mined for antimony on the spur now named after them, and lying a little north and west of Baker's Creek battery. Moore, Speare, and McBean followed by taking up an 80-acre block on the Southern side of this spur, and afterwards took up Portion 58. These portions were taken up under the now obsolete "mineral conditional purchase" conditions, and worked for antimony. At first the mining was performed by tributors, but the owners found these latter shooting much of the ore won down the hill slopes, so as to pick it up at their leisure in the creek below. To prevent this loss to themselves, Moore's party took up an additional portion of 80 acres, known as M.C.P. 110.

In 1878, Brackin, Daly, and Elliott found a long line of reef containing antimony. This was afterwards worked as the Isabella lode. It was discovered on the Hillgrove side of the gully, whereas the previous finds had occurred on the Metz slope. Another event was the discovery of the Paradise and No. 9 lodes, two antimony reefs, which after keeping company for some distance diverged from their original course, and struck out nearly at right-angles to each other. The continuations of these two lodes were found in the flat country above the gorge, and from them one parcel of 10 tons was extracted.

Another antimony lode was worked on Brackin's Spur, a prominent landmark near the junction of the Baker's and Four-mile Creeks. This lode turned out some very good ore. Junce and Kerseller, acting for an Armidale syndicate, opened up antimony smelting works near the head of Swamp Creek and treated the various antimony ores of the field.

Up to this time there had been no thought of gold, and, even when specks of the precious metal were discovered in the Garibaldi Reef, its significance was not appreciated, owing to the difficulty experienced in extracting gold from an antimony admixture. The first speck seen on the field occurred in No. 2 shaft of the Isabella line of reef, now known as the Garibaldi Shaft. Aaron Smith is credited with the observation.

After the Eleanora and Garibaldi had been worked for some time, the attention of the companies prospecting them was turned to the winning of gold, and in November, 1881, Mr. G. Smith was appointed by an Armidale syndicate to manage the Garibaldi property. Supposed payable gold was then found at the Eleanora, and a party of six from Armidale, exclusive of Brackin, Daly, and Elliott (who, as discoverers of the lode, were included) formed a company and took up a gold lease of 20 acres. Four tons were made up for the first parcel and sent to Sydney. Quick bought these on assay and shipped them to England. The return was 7 oz. of gold to the ton. 89 tons in all were sent away. At the end of 1882 and beginning of 1883 the Eleanora was put into a company of 12,000 shares. A 10-head battery, brought over from Stawell, in Victoria, was erected by Scoular. The battery was then increased to 25-head, and to anticipate slightly, G. Smith, who had bought back into the company, made preparations for the erection of 70-head of stampers in 1892, and which, in 1899, were utilised for the first time.

The Garibaldi Reef was still worked for antimony. In 1882 came a revival in the demand for this metal, and a consequent rise in price. In 1882 it brought £7 per ton in Armidale. Hargreaves, the owner of Hillgrove Station, had been working an antimony claim on the top of the Swamp Creek Falls. This was known as the continuation of the Paradise and No. 9 lodes. In 1885 he leased the claim to tributors, and imposed a royalty of £1 per ton on all the ore won. 141 tons of antimony were taken out of this reef in 1885 and part of 1886. Besides this amount, Hargreaves had previously extracted 91 tons. A slump occurring in the price of antimony, the value of crude ore going down to £4 10s. per ton, the lodes were prospected for gold. From these lodes, at various times, about 2,000 tons of crude antimony have been extracted, 500 tons from the top and 1,500 tons from the creek sides. The ore was carted up the gully at first by bullocks (Plate III), and afterwards drawn by trams.

In the middle of 1886 the Carrington lode, occurring in the granite north of the Eleanora, and worked previously for antimony, was opened up for gold. A sample of 2 tons was forwarded to the Sydney Mint. The total return was 5 oz. 13½ dwt. In the same year this lode was inspected by Neilds of Adelaide and Deitz of Temora. It was then formed into a company and prospected again.

In 1887 came the real opening up of the gold-bearing reefs of the district, when the Little, Big, Middle, and Baalgammon veins were discovered; when the lodes worked by Moore, Speare, and McBean, on the west side of the Baker's Creek gorge, were found to contain gold, and when the Cosmopolitan, Hopetoun, Starlight, and Centennial claims were taken up for gold-mining purposes.

In the early part of that year, G. Smith was invited by J. Elliott, G. Phillips, T. Asche, and N. O'Donnell to inspect something which they had unearthed on the Metz side of the creek. Accordingly, Smith started from Hillgrove to cross the gully, intending on the way to prospect the creek bed for himself. While crossing the stream he lighted on a piece of quartz carrying gold. Fixing the spot, he determined to trace the gold to its source on his return. A search led him to the outcrop of the Big Reef, where he found a strong body of stone, 4 ft. wide, containing much fine gold, the metal standing out above the weathered reef. He brought up a large piece of the stone to the town flat and dollied it there. So incredulous, however, were the local people that it required some little persuasion to arouse sufficient enthusiasm in a party from Armidale to bear the expense of the application and

survey of the lease of 15 acres. During the pegging out, the surveyor employed discovered a piece of quartz containing gold near the south boundary line. Smith traced this to a lode running parallel to the boundary throughout the length of the ground. Thus unwittingly was the "Little" or "Smith's" line of reef pegged in. Afterwards it was ascertained that the last-discovered reef underlay into the surveyed portion.

It was on the 27th March, 1887, that this 15-acre block was applied for. The finding of gold near the creek, however, was not absolutely a surprise, as an adjoining lode, named Hill's Reef, had yielded gold four years before. The inception of gold-mining operations on the Big and Little Reefs was attended with astonishing results. From 2 tons 6 cwt. taken from an open cut, the Sydney Mint obtained 105 oz. 9 dwt. by crushing. A large dolly with spring pole was next put up, and with this primitive battery, G. Smith and brother, two Millers, with two men on wages dollied out £2,500 worth of gold in four months. The property had been known as the "Four Brothers' Mine," but the name gradually fell into disuse. The first reef discovered was christened the "Big Reef," and the erstwhile "Little Reef" was renamed "Smith's Reef." A meeting of the shareholders offered one fifth share for a 5-head battery. W. B. Neild accepted the offer. A company of 100,000 shares, paid up to 17s. 6d., was floated, since which time the company have paid fifty dividends, amounting to £267,500. This mine has crushed 117,635 tons of ore for 188,812 oz. of gold (exclusive of that contained in the concentrates) since it started mining operations. Owing to its persistent success it has been the greatest factor in the stability of the mining industry at Hillgrove.

To return to the Sunlight, the finding of which slightly anteceded that of its richer neighbour, the Baker's Creek property. This was the find which Smith was requested by Elliott and O'Donnell to inspect. The discovery was made on Moore, Speare, and McBean's M.C.P. 109, and the reef previously worked for antimony. Two men, named A. Argles and J. M. Dalzell, representing themselves as capitalists, had just arrived from Sydney to examine a new find called the "Root Hog," situate to the north of the Sunlight, and now worked as the Hopetoun. Elliot and Party entered into an agreement with Argles and Dalzell concerning the Sunlight, as the latter considered the land to belong to the Crown. Moore, Speare, and McBean contended that the land was theirs, while Elliott's party pegged out and claimed to hold it under miners' rights. Argles and Dalzell, meanwhile, recognising the claims of Moore and Party, leased block 110 from them, while Elliott and O'Donnell contested the point, and thus rose a series of litigations, extending over two years, at the end of which period, Moore and Party were left undisputed owners of blocks 58, 109, and 110.

The total amount of gold won from the Sunlight reef since 1892 is 36,873 oz. 6 dwt., and from the West Sunlight since 1894 is 19,000 oz. These amounts are exclusive of gold contained in the concentrates, and only represent a portion of the actual gold yield, as the mines have been worked since 1887 and 1888.

The best of the gold deposits contained in the granite lie in that belt of country occupying the western slope of the gorge north of Baker's Creek property. The first claims pegged out included the "Root Hog," taken up in 1897. These were then formed into the properties known as the Hopetouns, and taken up by a Victorian company in 100,000 £1 shares.

In the same year (1887) that the reefs of the Baker's Creek property were discovered, Thomas pegged out, in the coarse granite to the north of the slate belt, a portion containing certain reefs, which appeared to him to lie on the same line as the Eleanora. The property was taken up as the North and

South Cosmopolitan, and worked for gold. Mining for the latter was soon discontinued in favour of antimony mining, as gold was scarce, but antimony very plentiful. Afterwards the land lay idle till some three years ago, when Thomas, Hay, and Parr pegged out afresh a part of the original lease, amounting to 2 acres.

Last July the Cosmopolitan and Carrington were amalgamated into "The Hillgrove United" by Fuller and Robinson. From the Cosmopolitan Reef, for the past two years, crushings have yielded 1 oz. to 27 dwt. of gold per ton of stone; 20 tons last year were crushed for 23 oz. 13 dwt. For these figures I am indebted to Mr. Fuller, of Hillgrove.

Some little time after the commencement of mining operations at Baker's Creek, "The Consols" Company took up a lease to enable them to work the southern extension of the Middle Reef and the north-west continuations of the Little and Baalgammon lines.

Among the more determined efforts to prove the north and south continuations of the Big and Little Reefs may be mentioned that of the Baker's Creek Gold-mining Company South, who drove two tunnels south of the Baker's Creek Company in a N.N.E. direction. The main tunnel has since been carried to a distance of 2,054 feet into the hill by the present Proprietary Company. Then, on portion 176, the Mount Carrington Gold-mining Company drove a tunnel into the hill 500 feet; but, after encountering a granitic dyke 10 feet wide, the idea was abandoned. To the north, Petersen and Party, Elliot and Party, as well as others, have prospected in vain; in fact, the whole of the later intrusive granitic mass to the north and west of Baker's Creek Company's workings has been pegged out and prospected, the men considering the fine-grained mass to be an indurated slate. The exceedingly rough country to the south-east—a tract pierced with dykes—has also been largely prospected.

Another line of reef that has been searched for beyond its present limits is the Sunlight. The West Sunlight Company, with their double lode, almost undoubtedly have the western prolongation; while Trimms and Murgatroyd, searching in the broken country to the east, claim to have hit the reef also.

The laying down of light tramways facilitated mining operations for such mines as the Baker's Creek, Sunlight and West Sunlight, Hopetoun, Cosmopolitan, and Carrington, all of which are situate in the gorge. The Baker's Creek Company led the way in 1889, and then followed in order the Hope-toun, the Sunlight, the Carrington, and West Sunlight.

Until telephones established communication between the top and bottom of the tramline, the Inspector of Mines would allow no passenger traffic.

The finding of high-grade scheelite near the town in the coarse granite is interesting, inasmuch as, so far, very few similar occurrences have been reported from New South Wales. The ore is confined to small lenticular patches in veins. The principal suppliers of the mineral are Keyes and Party, Maddricks and Party, The Hopetoun, and Wade's Party, near Brackin's Spur. Over 70 tons of scheelite were put into the market for the year ending December, 1899. Most of the ore was of good quality, varying from 50 per cent. to 60 per cent. of tungstic acid. Ten shillings per unit was paid for ore over 60 per cent. Keyes and Party, from two blocks, supplied 20 tons; Maddricks and Party, about 15 tons; Snow and Son, about 15 tons; Willmott and Company, about 20 tons. Most of this has been won during the half year ending December, 1899.

At present the Garibaldi, Eleanora, West Sunlight, and Golden Gate are not working, although the West Sunlight is expected to resume operations in February, 1900.

Summary.

- 1877.—Finding of antimony in quantity at Hillgrove. Working of the Sunlight for antimony.
- 1878.—Brackin, Daly, and Elliot found Eleanora Reef (antimony). Claimed Government reward.
- 1881.—Gold found in Garibaldi.
- 1882.—Revival in price of antimony, giving the mining of this material an impetus. Eleanora formed into company of 12,000 shares.
- 1883.—Hill's Reef discovered and worked for gold. Ten-head battery for the Eleanora brought over from Stawell.
- 1886.—Carrington Mine discovered.
- 1887.—Gold discovered in Sunlight Reef. G. Smith discovers Big Reef. Little and Middle Reefs opened up. Hopetoun discovered. Cosmopolitan Reefs pegged out. Sydney Mint crushed 2 tons 7 cwt. of stone from Big and Little Reefs for 45 oz. 17 dwt. per ton. Smith and party dollied out £2,500 worth of gold in four months.
- 1888.—Baker's Creek put up 10 head of stampers.
- 1892.—Baker's Creek increased crushing plant to 40 head of stampers.
- 1898.—Baker's Creek and Sunlight Reefs working with 40 head of stampers, Consols with 15 head, and West Sunlight with 20 head.
- 1899.—Eleanora increased battery to 70 head of stampers.

Gold Returns (exclusive of Concentrates).

Dates.	Oz. of smelted gold.		
	oz.	dwt.	gr.
Eleanora, July, 1892, to Dec., 1899	31,477	11	3
Consols, Sept., 1897, to July, 1899	3,550	12	0
Baker's Creek (total), March, 1887, to Dec., 1899	188,812	0	0
Sunlight, Jan., 1892, to Dec., 1899	36,873	6	12
West Sunlight, Jan., 1894, to July, 1899 ...	19,000	11	0
Garibaldi	Not known		
Golden Gate	2,100	7	0

Baker's Creek paid fiftieth dividend. 70 to 80 tons of high-grade scheelite won from lenticular patches in coarse granite.

3. PREVIOUS LITERATURE BEARING ON THE SUBJECT OF MINING AT HILLGROVE.

(a) In the Annual Report of the Department of Mines for 1883, Mr. C. S. Wilkinson, late Government Geologist, has a report on "The occurrence of Gold and Antimony Lodes at Hillgrove."

(b) Mr. J. E. Carne, F.G.S., Geological Surveyor, mentions the presence of scheelite in this locality in his pamphlet entitled "The occurrence of Tungsten Ores in New South Wales," published as No. 2 of the "Mineral Resources" series of this Department.

Various reports by the Inspectors of Mines and Wardens may be found in the Annual Reports for 1889, 1890, 1895, and 1898.

4. PHYSICAL GEOGRAPHY.

- (a) Drainage system. (b) Topography. (c) Ravines. (d) Scenic features.
 (e) Meteorology. (f) Influence of the ravines on mining industry.

(a) DRAINAGE SYSTEM.

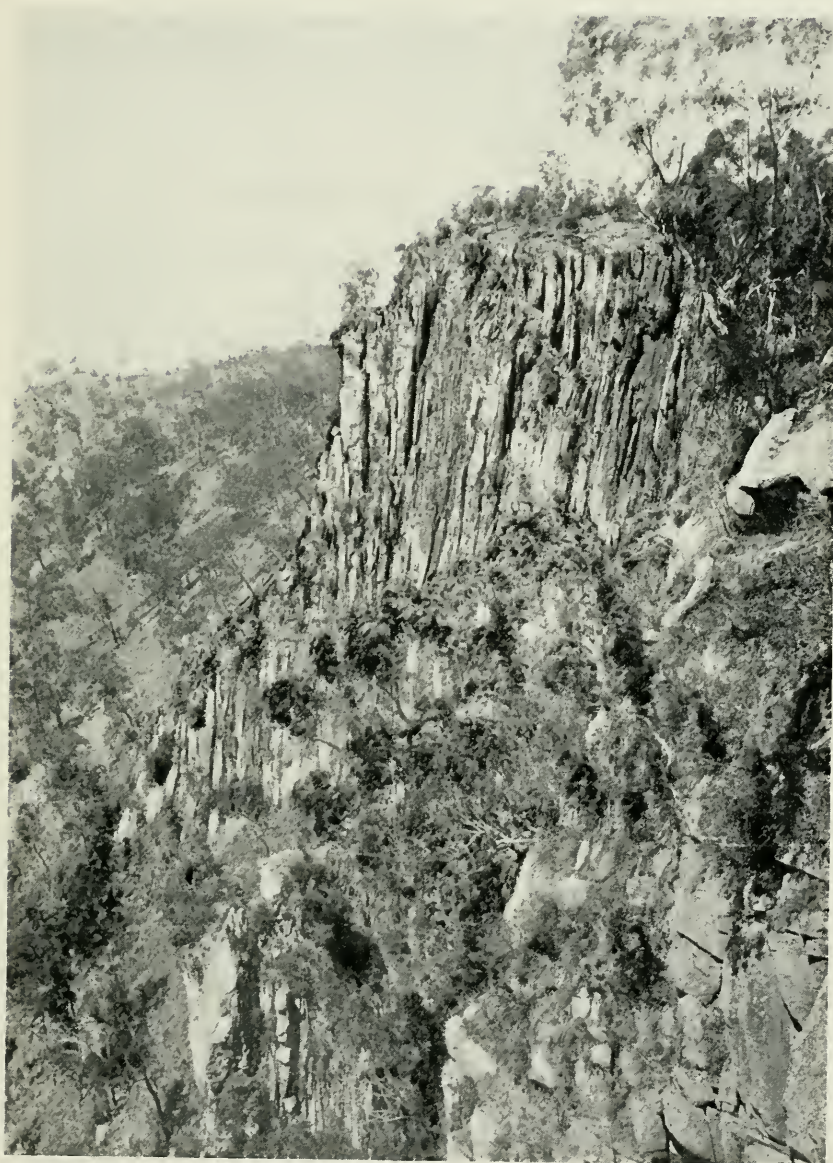
Baker's Creek and the Gara River, the main drainage channels of the Hillgrove area, belong to the eastern or coastal system of rivers, their united streams forming one of the head waters of the Macleay River.

(b) TOPOGRAPHY.

To one approaching Hillgrove from the west the general effect produced is that of evenly undulating country, with isolated and rounded hill masses rising above the gentle curves of the granite downs. Here and there late basalt outflows have produced extensive flats, and on these grass grows more luxuriantly than on the poorer contiguous granite areas. Clusters of curiously-weathered granite tors are of frequent occurrence; these, in silhouette, at times are grotesquely suggestive of animal and human outlines. The continuity of the granite plateau is broken, however, at the town itself, where a general east and west line of granite and slate junction occurs. This is the signal for a marked change in the topographical features of the district. The creeks, which have flowed through the table-land in broad and shallow beds, precipitate themselves over great ledges of rock nearly 1,000 feet in height. Several natural trenches, the outward and visible sign of the eroding waters, have been deeply cut into the slate and granite plateau. These are disposed in, approximately, a north and south direction, and contain, throughout their length, a marvellous wealth of rugged slope and precipice. In the vicinity of the town four such cañons may be crossed in an east and west traverse of two or three miles. Near the mines, Baker's Creek ravine is 1,500 feet deep, while a few miles lower down, where beds of soft black slate occur, the steep escarpments rise 2,500 feet above the creek-bed. Where the granite has been the rock attacked by the denuding influences, the gully sides are generally rough, and show large rounded blocks resting upon cuboidally-jointed rock-masses. At the heads of Baker's, Swamp, and the Four-mile Creeks the sides are quite precipitous, varying from 600 to 1,000 feet in height (Plate III).

(d) SCENIC FEATURES.

The scenic effects are at times weird and grotesque. In the granite country rectangularly-jointed masses simulate piles of masonry. Generally tall, ribbed, precipitous bluffs obtain in the slate country (Plate III). In Swamp Creek a great bluff of slate occurs, almost 1,000 feet in height, and exhibits bedding or joint planes bent almost into a semicircle. Sometimes long, narrow belts of slate, determined in shape by the cleavage, creep across the valleys. In places these tongues and solitary needles of indurated slate reach skywards for hundreds of feet. The sides of the slopes are barren as a rule, and lack both that warmth of colour so frequently seen on the sandstone bluffs of the New South Wales gorges and the dense vegetation that swarms at the bases of ravines generally.



To face page 12

SLATE AND GRANITE JUNCTION, HEAD OF SWAMP CREEK.

(e) METEOROLOGY.

The altitude of Hillgrove township is 3,150 feet above sea-level, and the average rainfall is 40 or 41 inches per annum. Severe frosts occur in winter, which have a tendency to split the rocks, while during the summer the sun glows fiercely on the unprotected sides of the gorges. Very high winds desolate the plateau at times. One during my stay in November uprooted scores of trees, and shifted huge stones that tore up the mountain tracks as they darted down the gully sides. Thus, besides the transporting effect of water, the power of the wind and the alternations of heat and cold must not be overlooked as factors in the carving out of these ravines.

Severe floods are at times experienced. In 1893 a rush of water moved an angular granite block of forty tons some two chains lower down the creek, and this on fairly level ground.

(f) INFLUENCE OF RAVINES ON THE MINING INDUSTRY.

The commercial significance of these hill slopes with respect to the mining industry at Hillgrove will be seen at once :—

(a) As a source of expense.—In the need of costly tramways to expedite conveyance of material up and down the slopes, where beasts of burden would be almost useless ; in the discounting in value of minor mineral deposits situate on the slopes of the gorges, owing to cost of haulage and element of danger involved in coping with the numerous landslips which occur, particularly in the antimony area of the Swamp Creek.

(b) As a source of gain.—As a set-off to the loss entailed in travelling and hauling on the steep sidelings may be mentioned the power obtained by water conserved in dams situate on the table-land, and conveyed down the slopes in pipes ; and the facility with which some of the reefs may be won by tunnelling into the hill from the gully sides.

5. GEOLOGY.

Various rocks of the field. Chronological order of geological events.

(a) Sedimentary rocks. *(b)* Eruptive rocks—First granite intrusion, second granite intrusion, third intrusion, fourth and latest intrusion ; dykes. The slopes of granite bosses. *(c)* Metamorphism ; the sedimentary rocks ; the “kicking” slate ; the eruptive rocks. *(d)* The lodes—Direction of strike ; origin ; later movements ; cross courses ; occurrence and nature of ores. *(e)* Geological events subsequent to the formation of lodes—Metamorphism ; erosion ; old river beds ; Tertiary basalts ; erosion of rocks to form present ravines. *(f)* Petrological notes on the Hillgrove rocks.

GEOLOGY.

Broadly defined, the geology of the field consists of a series of fine sedimentary rocks, broken into and altered by several granite masses, and by dykes of granitic origin. On the eroded portions of these ancient masses lie quartz pebble drifts covered by basalt flows.

CHRONOLOGICAL ORDER OF GEOLOGICAL EVENTS.

In the present state of our knowledge, it would be premature to insist on any definite order of succession among the various strata and subsequent eruptive rocks.

The slates and quartzites are probably the oldest rocks of the field. These are traversed by dykes of granitic origin, and these in turn appear to be of great age, as they have shared in the whole of the regional metamorphism of the district. It is probable that the older fine-grained masses of granite lying in the Four-mile Creek, and in its neighbourhood, either sent out the older dykes that pierce the sedimentary rocks, or were at any rate contemporaneous with the older dyke-forming epoch.

To the south a coarser and greenish granite has been intruded into the slates. In places it is a felspar-porphry. It is in the shape of a huge bar running east and west, and cut off, both to the east and west, by the coarser granite of the field.

Subsequent to this intrusion a large mass of biotite granite, or granitite, penetrated the older masses, and cut across the slates and other sedimentary rocks from east to west.

The bluff of rocks, west and north-west of the Baker's Creek Company's workings, represents the material forced into the slates by the latest granitic intrusion. It differs from the other plutonic masses in not being of coarse texture, but showing to the unaided eye simply a very fine crystalline appearance.

After a long period of quiescence, during which the great granitic bosses were first exposed, then eroded nearly to their present level, Tertiary basalts made their appearance, diverting the rivers into new channels.

(a) SEDIMENTARY ROCKS.

Possibly the oldest rocks on the field are the altered slates, schists, and quartzites. These in the Hillgrove area itself are confined to a sub-rectangular shaped mass, two miles in length and some three-quarters of a mile in breadth. A narrow strip of altered slate is continued on from the main mass in a westerly direction, and contains the Sunlight lodes in its course. This small belt averages but a few hundreds of yards in width. A great bar of granite has cut across the direction of the slate outcrop, some 1,000 yards below Baker's Creek Mine workings, and from that point the slate continues for miles down the creek, but with a slightly varying strike. On the gold-field itself, the sedimentary rocks consist of slates, knotted schists, mica schists, quartzites, siliceous schists, and siliceous slates, much contorted in places, but generally preserving a strike N. 20° W. Between Murgatroyd's tunnels and the Garibaldi dam the strike passes gradually from N. 8° E. to N. 23° W., and the dip changes from a slight easterly direction to an almost insensible westerly one. In one place, between the tunnel and the dam, the dip is vertical. At Whittaker's Spur and the Swamp Creek, local disturbances have bent the slate sharply. Two readings taken in the Swamp Creek were respectively 35° and 70° towards the west.

In rare instances both dip and cleavage show beautifully, and the slates are black and blue-black in colour, with white intercalated bands coinciding with the strike of the beds.

Mr. W. S. Dun, Palaeontologist to the Geological Survey, has examined several of these rocks in thin sections under the microscope, for the presence

of radiolaria. One of these had the appearance of a radiolarian rock, but was too much altered for the satisfactory preservation of these organisms. Others exhibit no traces of radiolaria.

Again the slates often pass insensibly into a knotted or spotted schist. Near the centre of the area occupied by the derivative rocks, a curious rock mass occurs, which on superficial examination shows a striking resemblance to a fine-grained igneous rock. It is, however, of sedimentary origin. Interbedded with this rock are thin beds of spotted or knotted schists. By determining the direction of the schist and "highly altered" rock-junction, the strike of the latter was arrived at; it was N. 10° W.

Towards the Four-mile Creek, quartzites, siliceous schists, and mica schists occur, but the rocks are too altered to show signs of dip and strike at the surface. For a similar reason there appears to be no trace of former organisms that may be contained in the strata. A soft, black, cleaved slate, occurring several miles down the creek was searched for fossils, with no success however, although everything seems favourable in the slate for the preservation of organisms.

Several prominent jointings occur in the slates. Of these two are very marked, one occurring at an angle of 15° to 20° to the strike of the beds, and dipping at a high angle. The other is of lower angle, rarely exceeding 20° or 30°. Another subordinate system of jointing is also common. Plate III illustrates well the most pronounced of these jointings.

(b) THE ERUPTIVE ROCKS.

The First Granitic Intrusion.—The remains of an old granite rock are found in various parts of the field, particularly in the bed and eastern slope of the Four-mile Creek, near its head. In places it has the appearance of a fine-grained white sandstone, in others of a fine-grained but much altered granite. In the Four-mile Creek it appears to be broken into by the main granite mass of the field. In the bed of the same creek, a mass of angular fragments of a fine-grained rock are cemented together by larger and smaller veins of a younger and coarser intrusive rock, which has broken up the finer-grained mass. These fragments may belong to an older granite mass. Professor David has informed me of the frequency with which, in New England, a coarse granite has broken and intruded into an older finer-grained rock. In walking from Bolivia to Deepwater, along the railway line, one sees splendid illustrations of this intrusion of coarse granite into fine, exposed in the cuttings. It is possible that the oldest dykes of the field which show so much evidence of metamorphism, represent one phase of this older granitic intrusion. These dykes are green in colour, and weather out into a yellowish or brownish earth showing much decomposed micaceous material.

Second Granitic Intrusion.—There is another granitic mass on the field which appears to be older than the wide-spread coarse granite. It runs as a belt east and west across the southern part of the field, and is exposed only in the Baker's Creek gorge, where the coarser granite has truncated it at both extremities. In a small creek on the Long Point Spur, a whole mass of sub-circular fine-grained fragments have been caught up by the coarser granite rock. The phenomenon occurs near the granite and schist junction.

The rock is generally compact, fine in grain, and green in colour owing to its wealth of decomposed ferromagnesian minerals. The red soil resulting from its decomposition, its green colour and its weight are suggestive of a more basic origin than granite. Its innumerable segregations are notable, both in forms of veins and irregularly shaped masses, as much as ten yards in

diameter. The edges of these latter shade off insensibly into the enclosing magma. The minerals enclosed are quartz and feldspars. The coarse segregations have the appearance of gabbros or diorite from the colour, the occurrence of the ferromagnesian constituents, and the great quantity of striated feldspar. Near the junction of this rock with the slate, a mass of broken fragments occurs similar in appearance to kindred displays mentioned in previous paragraphs. This broken mass is not confined to a mere selvage in width, but persists for a distance of some two or three hundred yards, measured at right-angles to the strike of the slate and granite junction. Both at the Long Point Creek spur, and in the bed of the Four-mile Creek, this brecciated appearance occurs near the sedimentary rocks.

Huge dykes have been sent by this mass into the surrounding slates. They are highly altered; they show large white feldspars and at times elongated blue quartzes; they have generally been thought to be diorites.

The Third Granitic Intrusion.—This, the main acid intrusion on the field, is important as regards its mass, its action on the sedimentary rocks, and the part played by it in the formation of the lodes.

In appearance this coarse granite is black on fresh fractures, by reason of the abundance of dark mica, and it also contains much plagioclase. Large idiomorphs of feldspar, with corroded contours lie scattered plentifully throughout the mass. It is markedly gneissoid, crushed or otherwise altered in places.

Most of the gold and antimony lodes are connected with this boss, besides which the scheelite veins, almost without exception, are contained in it.

The Latest Granitic Intrusion.—The last granite outburst connected with this field occurs as a bold escarpment, 400 yards wide, 1,500 feet in height, and in position exactly opposite the Baker's Creek Mine tramway. It is exceedingly fine in texture, very tough, and has a glistening appearance on fracture. Most of the miners of the field are so deceived as to its true structural affinities as to designate it a baked or hardened slate. Plutonic rocks consolidate as fairly coarse crystalline mineral aggregates—to wit, the other granites of the field—and are supposed to have cooled at great depths below the surface, but cooling appears to have acted rapidly in this granitic mass, as though it had consolidated nearer the surface.

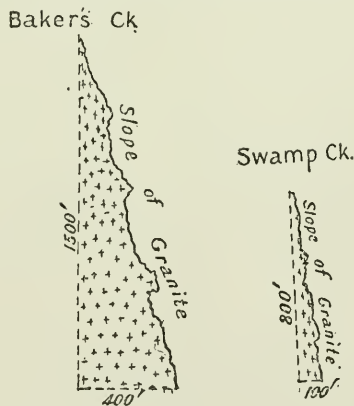
The tailings in the creek near the Sunlight, Baker's Creek, and Proprietary Mines, obscure a history that would otherwise be easily read concerning the relative ages of three of the granitic masses of the field. Enough is exposed, however, to show that a long tongue of feldspar porphyry, sent out from the green granite to the south, passed through Murgatroyd's and Trimm's tunnels, and was cut through by this latest eruptive rock. Beyond the fine granite, traces of the feldspar porphyry tongue exist as dykes near Baker's Creek workings. This fine rock has also sent narrow felsite dykes into the slate. In one place near the Sunlight bridges, the hard black slate is pierced by narrow ribbons of felsite, more or less parallel to each other. Many of them are of the character of small sills, and, generally speaking, they supply clear evidence of the intrusive nature of the granite. The habit of this intrusive rock is more that of a dyke than a boss. Measurements taken near the Sunlight Reef indicate a vertical slope for the granite at that particular spot. Two or three long lines of dykes passing through the coarse granite were traced to within a couple of hundred yards of the granite under consideration. In appearance they were similar to undoubted dykes sent out from the fine-grained rock.

Dykes.—A reference to the map will serve to show how many occur in the restricted area of the mines. The beds of Baker's and Swamp Creeks are full

of them. Several accompany lines of reef—*e.g.*, the Eleanora. Others break across reefs. Some appear to have partaken in all the general metamorphism of the area—*e.g.*, the Eleanora and Freehold dykes. Another felsite dyke, four feet wide, running like a wall up a vertical bluff of slate two hundred feet high, outcrops near the Garibaldi dam. This rock contains numerous crystals of hornblende and epidote. The Little Reef in its northern end, the Creek near the Sunlight battery, the Upper and Lower Cooney tunnels, are all intersected by these granitic intrusions, while great felspar porphyry dykes, ten feet wide, cross the line of the Little Reef, Portion 176, Murgatroyd's tunnel, and Baker's Creek; these proceed from the green granitic mass to the south.

The Slopes of Granite Bosses.—Observations in Baker's Creek, Swamp Creek, and Four-mile Creek, give much steeper angles of slope for the granitic bosses than might be expected. The junction of slate and granite on the eastern and western lips of the falls was obtained in these creeks, and the position of the junction between these two rock types was also fixed in the creek bed. Then, by drawing a line at right-angles from the junction in the creek to a line joining the two fixed points on the edges of the falls, an approximate idea of the original granite slope was obtained. In Baker's Creek the granite had advanced 400 feet in a vertical height of 1,500 feet—*i.e.*, less than 1 in 3. In Swamp Creek the advance was 100 feet for a vertical drop of 800 feet. In the Four-mile Creek the slope was almost nil, and in the Sunlight lode, also, the slope approximated to the vertical. The slope of the Sunlight granite was observed per medium of the tunnels.

Sketches showing the slopes of the Granite Bosses in Baker's and Swamp Creeks.



(c) METAMORPHISM.

The metamorphism of the slate has been alluded to before. In places the rock has been altered almost beyond recognition, soft black slate being changed to hard siliceous varieties; rocks belonging to the nodular and spotted schists, and one resembling a fine-grained variety of eruptive rock. In both slates and older granites numerous lodes occur, and cross-courses of two pronounced types, both of which have altered the country, causing heaves from an inch to twenty feet.

In one place in Baker's Creek a peculiar phase of metamorphism is found in the so-called explosive slate. Along the Little Reef, on the lower levels, particularly Nos. 10 and 11, and in the upper levels of the Sunlight Reef, a variety of slate is worked that tends to explode or "kick" spontaneously. On striking, or on boring with a drill, this treacherous ground will fly out in all directions with great violence. On one occasion a couple of miners were drilling a hole in No. 11 level, when a "kick" occurred. A lump of stone, about 50 lbs. weight, was hurled out of the wall, and after passing through a 3 in. x 2 in. scantling cut a man's body in two. Another driller lost an eye, another his nose and scalp, while many have been buried in the débris attendant on one of these outbursts, but these have escaped with bruising. Stulls placed normally to the walls are frequently smashed, or the ground about the foot of a stull is driven out, leaving it on a small shoe of slate remaining on the foot wall. For days before a "kick" occurs along a bad level the slate "spits," and fragments are given off at intervals. All that is then needed is a sharp hammering or a drill hole to be put in for an outburst to take place. Along No. 11 level this slate occurs in slabs, polished on the outside, while inside it differs in no respect, macroscopically, from an ordinary hard black slate. The best examples of the "kicking" rock have the marked jointing of the field, but break with conchoidal fracture, and are curiously curly in structure.

It seems to be merely a result of great pressure, derived probably from the compressing forces exerted by the various local granitic intrusions. In driving levels this "kicking" is rarely observed. It is only when the pressure is still more relieved, as for example, by stoping, that the slate bursts out with the force of a dynamite shot. Some observers imagine the slate has been subjected to fusion, and they find an analogous case in that of the Prince Rupert drops, which are pieces of molten glass, suddenly cooled by causing them to drop into liquid while in a molten state. A thin crust of cooled glass forms immediately, but the whole central portion is held in a state of such strain that on allowing one of the "drops" to fall, the thin outer ring of rapidly cooled glass cracks, the pressure is relieved, and a violent explosion occurs. The two cases are not identical. In the first place the "drops" are of fused material, while the paleozoic slate has suffered nothing like fusion. Even had the slates been fused, at the great depths they occur they could not have cooled quickly, so as to have a pent-up central portion inside a rapidly-cooled shell. Another group of inquirers has referred the origin of the explosions to pent-up gases in the slate, but this is as untenable an hypothesis as that of fusion.

If an elastic body could be pressed down by some Herculean force so as to occupy a smaller space than it would under normal conditions, and then secured in this position by strong steel clamps, so fixed as to form an immensely thick "strong box," encasing the imprisoned body, we can form some idea as to the behaviour of the slate. The removal of one or two clamps would make no perceptible difference in the state of the imprisoned body. As, however, the releasing process was continued, there would come a time when perfect equilibrium would exist between the forces of expansion and compression. Then the least further release would result in an explosion. This seems to be the condition of things on the Little Reef levels. Several series of granitic intrusions have occurred in the vicinity, causing, especially during the last intrusion, great compression of the slates. The driving of a level along this tightly packed area results in "spitting" and minor "kicks" only, as the side thrusts of the walls and other forces would keep the solid rock fairly intact. As, however, stoping went on, thus relieving pressure in more than one

direction, the expansive and compressive forces would approach the state of equilibrium. This would be heralded by the "spitting" of the slate. When the state of equilibrium was reached, the least tap with a hammer would result in a disastrous explosion. Frequently this stage is reached by firing a shot; tapping, after this, is attended with "kicking."

Another feature is the metamorphism of the older granites of the field, where crushing has taken place. In some of the coarser granites, notably the green basic variety, south of the gold area, a structure has been induced by dynamic metamorphism that resembles the bedding of stratified material. In others the quartzes are elongated into sub-elliptical forms, and in places appear to be of secondary origin. Frequently whole areas of rock are polished, and coated with green material, wrongly called serpentine by some mining men. Plumbago is present in some quantity in portions of the older green granite, and flucan derived from the crushing of this rock is at times quite black and tough.

(d) THE LODES.

The largest and most important of these have a north-westerly and south-easterly course, and underlie to the east at a steep angle, varying from 0° to 25° from the vertical. In the case of the Eleanora and Freehold Reefs, large dykes follow their strike closely. The Big and Little Reefs, the Middle Reef, and Hill's Reef, are crossed by dykes. When dykes follow the reefs they are older than the lode material. Thus the Eleanora and Freehold Reefs appear to have opened along the line of the dykes, and to have been charged with minerals subsequently. The continuation of some of the large reefs into the main granitic mass, the general parallelism of the strike and dip of all the main reefs, the ore characteristics of the same, and the general north and south tendency of the principal cross-courses, all tend to prove a common age and origin for the lodes, and that origin to be traced to the main granitic upheaval. It is very probable that the main lodes were determined by the upheaval of the granite and the cross-courses by its settling down; the lodes dip to the north-east, and occur on the eastern side of the main granitic axis of the district. The Sunlight lode has opened again since that time, possibly as a result of the latest granitic intrusion. The Middle and Little Reefs intersect, but do not throw each other. According to Mr. Barnet, formerly underground manager in the Baker's Creek property, the Middle Reef was strong at the intersection, while the Little Reef was reduced to a few irregularly-distributed quartz threads.

A predominating system of cross-courses runs north and south, and underlies to the east, and gives rise, generally, to "right-hand" heaves of the lodes. Their underlie varies from 0° to 20° from the vertical. Gold frequently occurs in their neighbourhood. Another set of cross-courses have a more east and west direction, and these also have thrown the reefs. In isolated cases reefs have been thrown as much as 12 feet out of their course. In the case of the Eleanora Reef, the lode occurs on both sides of the dyke. Where the dyke has made a slight roll horizontally, the reef appears to "sit" on the bulge so caused. When the reef opened alongside the dyke, and the hanging wall slipped on the foot wall, a massive slate breccia was formed, which was cemented by quartz and sulphide of antimony, deposited from ascending thermal waters.

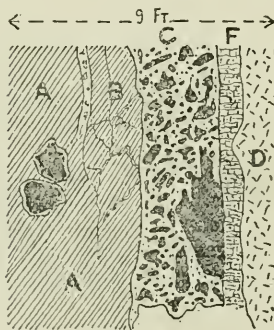
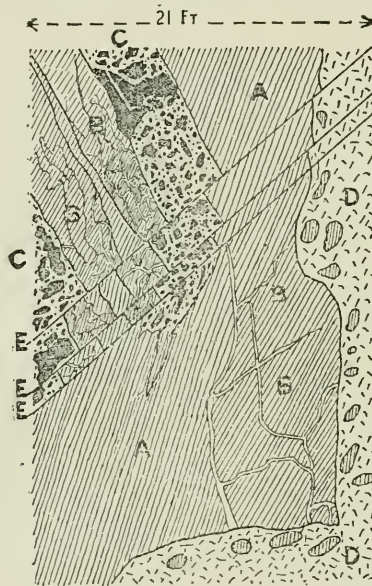
The reefs consist principally of quartz alternating with stretches of barren crushed slate and quartz, or hard slate. Polished surfaces are frequent, as also flucan bands. In the granite lodes a green selvage of crushed ferromagnesian rock is visible.

The scheelite lodes pinch in and widen out with astonishing rapidity. They are mostly small deposits, and antimonite is associated with the scheelite. In the Hopetoun, gold is said to pinch out when the scheelite makes, and *vice versa*.

The principal matrix of the gold is quartz, but stibnite also is present in great quantity, sometimes as magnificent crystal specimens filling vughs, at other times in hair-like masses, and at others amorphous. Some specimens look much like Jamesonite.

The quartz is translucent to white and opaque. The breccias of the Eleanora and Sunlight Reefs are distinctive, both as to the general shape of the slate fragments and the quartz cementing.

Roof of Drive in North End of No. 6 Level, Eleanora Mine.



Reference.—A Jointed slate. B Slate traversed by net-work of quartz veins. C Slate breccia cemented with transparent and white quartz. D Felsite dyke filled with nodules. E E E Faults. F Antimony.

In the unoxidised ore the metallic minerals, besides gold, are sulphide of antimony, arsenical pyrites (white mundie), and a little bournonite (?).

In some of the reefs good gold is visible; especially is this the case in the Little Reef, where specimens occasionally turn up quite thick with coarse gold. The gold is often quite red, having the appearance of copper.

The steepness of the gorge slopes seems to prevent the accumulation of thick oxidised ore masses, as the heavy and frequent rains would sweep this softer material into the gully.

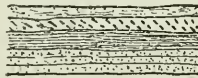
The reefs are often 12 to 18 inches thick. The Big Reef outcropped strongly on the surface, showing 4 feet width of stone. The Little Reef, however, is but a filament of quartz over long distances.

Besides gold, which ranks first in value among the mineral products of the field, antimony has been and is still, in a less degree, a source of profit. Of late the discovery of bodies of schelite has opened up quite a field for the smaller miners and fossickers, as the coarse granite appears to contain innumerable small lodes of this mineral.

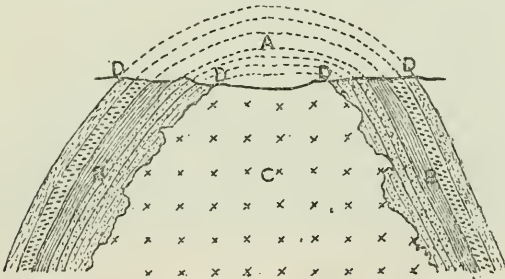
(e) GEOLOGICAL HISTORY SUBSEQUENT TO THE FORMATION OF THE LODS.

This is recorded principally in the wondrous amount of degradation that the rocks, once superior in position to the granite, have been subjected to. This area is a fine example of "earth sculpture" by epigene agents on disturbed slate and disturbing granite. The plain of accumulation, caused by carboniferous or older sediments, which had been laid down by the sea, was intruded and forced into folds by the great carboniferous (?) granite massif now forming the axis of the New England plateau. The exact amount of sediment eroded since this distant period is not known; but it must be enormous, since the Carboniferous or earlier formed strata, the highly inclined relics of which are greatly in evidence around the gold-field, are some thousands of feet in thickness.* A reference to the diagrams will illustrate this:—

Carboniferous (?) Slates, &c., horizontally bedded before
Granitic Intrusion.



Carboniferous (?) slates, &c., folded by Granitic Intrusions.



A Original anticline removed by denudation. B Sedimentary rocks—Carboniferous (?) slates, &c., after granitic intrusion. C Granite massif. DDDD Present surface

* For particulars of this, see Professor T. W. E. David's description of New England in Gympie (?) times, in his Presidential Address to the Royal Society of New South Wales, 1894.

The right-hand side of this section, D' D', gives some idea of the appearance seen to-day in the district,† which is the eastern aspect of the great anticline. Clearly the portion represented by the dotted lines must have been carried away by epigene agents. And this has been done so effectually that the flowing contours of the present hills show to the untrained eye, no trace of degradation from a mountain system to a low plateau or plain. The river system of the ancient granite plateau was a fairly mature one, as the forces of erosion had reached that stage when the soft contours which mark the "death of the mountain" had succeeded to the peaks of circumdenudation, with the usual accompaniments of buttress and precipice that had resulted from the forces of erosion acting in the earlier stages on the Palaeozoic slates.

Later in geological time, a great Tertiary basalt outburst flooded the Hillgrove and Metz area, filling the water-courses, and forming flats here and there. Previous to this event Baker's Creek and Gara River were united, and flowed where the town of Metz now stands. The basalt outflow diverted these streams into different channels. The waters now forming Baker's Creek attacked the highly inclined slate, and hollowed it out along the line of outcrop, thus carving out for themselves approximately meridional channels. The slates were rapidly eaten back, particularly in spots where, as at Swamp Creek, there was any resemblance to anticlinal structure, until the great east and west line of granite and slate junction was reached. The cuboidal jointing of the granite soon led to its degradation in turn, but not along the rapid lines that the slate had been attacked. This explains the appearance of the creeks to-day, with their deep gorges in the slate country, and precipitous and narrow ravines in the granite. The whole of the Baker's Creek ravine, as also that of Swamp Creek and Four-mile Creek has been eroded since Tertiary times—possibly Pliocene. (Plate IV, also plan.)

(f) PETROLOGICAL NOTES ON SOME HILLGROVE ROCKS.

Both in macroscopic and microscopic examination the rocks of the Hillgrove area exhibit the influences of metamorphism. The ferromagnesian elements may be observed to pass into large masses of brownish or green material. They are rarely seen in a clear state, but are often replaced by viridite. The felspars are faulted in a remarkable manner, and are frequently kaolinised or replaced by epidote, secondary quartz, and secondary felspar. Much of the felspar being plagioclase, it alters in conjunction with the biotite to saussurite. The prevailing types of rock at Hillgrove belong to the granitites, although a red rock at Gara shows affinities with true granites. These granitites in places are of very basic variety. One or two types would, by some observers, be referred to the intermediate rocks. Mr. J. A. Watt, M.A., B.Sc* classes the eruptive rock containing the gold lodes at Wyalong as a very basic granite, showing great affinities with the quartz-mica diorites of some petrologists.

The holocrystalline rocks of acid composition in New South Wales will be found very frequently to belong to the granitites rather than to the true granites.

Slide 1,669.—Biotite granite from main granitic mass, near Township.

Macroscopic Characters.—A dark holocrystalline rock, porphyritic, with large felspars, rectangular to sub-elliptical in outline. Decidedly gneissic in appearance.

* Mineral Resources, No. 5, page 15.

† In reality, the strata were thrown into a series of folds, and were faulted in many places.



BAKER'S CREEK GORGE, LOOKING SOUTH FROM CAMPBELL'S SPUR.

To face page 22.

Microscopic Characters.—This rock is full of plagioclase, orthoclase being poorly represented. There are two crops of felspar. The first crop consists of phenocrysts, as much as two inches in length, representing the intratelluric phase of crystallisation. Many of these crystals have edges so corroded as to have lost their original rectilinear outlines and to possess sub-elliptical contours. Some of the triclinic felspars belong to the potash variety known as microcline, having an appearance of plaited basket-work under crossed nicols. Albite and carlsbad types of twinning are observable at times in the same crystal. Schillerization occurs in certain crystals. The second crop of felspar consists mostly of small plagioclase crystals of glassy habit, twinned on the albite plan. Interpenetration twins and compound multiple-twinning not uncommon. Biotite and muscovite are both present. Some of the less decomposed of these polarise in high colours; the edges are frayed, and the crystals are often drawn out into long curvilinear lines. Decomposition products are present as viridite and saussurite. Quartz is present in fair quantity, also in secondary form; sometimes observable in the centre of plagioclase crystals. Scattered grains of a mineral possessing fairly high refractive index occur throughout the slide. Under crossed nicols the colours are dark blue to black. Apatite is present in quantity as rods and stout crystals. Magnetite also occurs. Lustre-mottling is also observable in this slide.

Slices from Rock Specimens 3,908, 3,913, 3,665.—Locality, Baker's Creek, near junction with Four-mile Creek. These rocks represent phases in the cooling of a very basic granite. They are much altered, and flow structure is not uncommon.

Macroscopic Characters.—Dark holocrystalline rock showing bronze-coloured micas, decomposed hornblendes and biotites.

Microscopic Examination.—The felspar is represented principally by plagioclase. Much of this is kaolinised, while a later crop of the same mineral is of lathlike and glassy habit. Beautiful examples of faulting occur in the felspars (Plate X), and in other crystals under crossed nicols, the alternate light and dark bands, due to multiple-twinning, are in curved lines as a result of crushing. The plagioclase in places is altered to epidote, as grains and irregular patches. Several crystals possess a thin outer-ring only of felspar, the centre being occupied by epidote. Individual crystals show twinning on both carlsbad and albite plans. Ferromagnesian minerals, as biotite and hornblende, are present in great quantity. Both are generally highly altered and the slides are full of viridite and a fair proportion of saussurite. Muscovite is also present. Primary quartz is a minor constituent. Secondary quartz is present. Apatite and magnetite are well represented.

This rock has a high specific gravity, and by some petrographers would be referred to the acid end of the diorite group.

Rock Specimen 3,911.—Granite from Gara River, five miles west of Hillgrove township.

In hand specimens this appears as a beautiful pink holocrystalline rock of medium coarseness. Strings of epidote occur throughout the rock.

Under the microscope the felspar is seen to consist of both triclinic and orthoclase varieties. Orthoclase is present in abundance, the crystals being quite cloudy through kaolinisation. Sections of plagioclase occur showing interpenetration twins. Both orthoclase and plagioclase are crossed by strings of epidote.

Much decomposed biotite is present. Quartz is greatly in evidence, the crystals being quite speckled by reason of numerous liquid and gaseous inclusions.

Apatite occurs in stout prisms and long needle-like forms. Iron pyrites is present in abundance.

Rock Specimen 3,999.—Fine-grained granite from Four-mile. Extremely altered, having appearance of fine-grained white sandstone in places. Biotite is present, but much altered, sheared and drawn out in threads by dynamic metamorphism. Felspar occurs as plagioclase and orthoclase, much kaolinised. There is a great development of secondary quartz. This rock belongs to the oldest granite of the field, and shows relationship with the granitic inclusions in the main mass.

Rock Specimen, 3,966, Slide 3,966.—Quartz-felspar porphyry from No. 3 level of the "Little Reef," Baker's Creek Mine. This appears in hand specimens as a fine-grained dark rock, porphyritic with white felspar crystals.

The microscopic examination of this rock reveals the influence of long continued metamorphism. The base is microcrystalline to cryptocrystalline, and exhibits "flow structure" in the vicinity of the porphyritic constituents. These latter consist of idiomorphs of plagioclase, representing the intratelluric stage of crystallisation. Interpenetration twins and cross-twinning are common. Zonal structure is noticeable in the plagioclase. The second crop of felspars is composed of stout squarish triclinic and orthoclase crystals.

The biotite is much altered in places to non-pleochroic brown and green products, and appears drawn out into wavy lines. Apatite and iron oxide are present.

Rock Specimen 3,967.—Felsite from dyke near Garibaldi Dam.

Cryptocrystalline base, with numerous small hexagonal and lozenge-shaped sections of transparent greenish-brown amphibole.* These crystals are of rod-like habit, and exhibit twinning. The mineral is pleochroic. Sections cut parallel to the plane of symmetry yield more brilliant colours under crossed nicols than those cut in the orthodiagonal zone.

Epidote, apatite, and magnetite present.

Rock Specimen 3,970.—Dyke in Swamp Creek. This rock is a felsite of much fresher appearance than the ordinary types of Hillgrove eruptive rocks. Micas are very plentiful, with well preserved edges and exhibiting brilliant polarisation colours.

Rock Specimen 3,971.—"Kicking" slate from No. 11 level, "Little Reef."

This rock possesses a remarkable curly structure, and contains veins of secondary quartz. Alteration products are present.

Notes on the so-called "Pebbles" of the Eleanora Dyke.

The dyke-rock belongs to the basic granitic type, and is much decomposed, the biotite being changed to viridite, and the plagioclase to saussurite.

Throughout the dyke, numerous pieces of a much decomposed and very basic rock occur, having the rounded contours characteristic of pebbles. In places where the dyke has bent slightly from a straight course, the included portions occur in such abundance as to resemble a conglomerate. These fragments fit into distinct sockets, and may be released, when they impress the uninitiated with their pebble-like habit.

They consist of ultrabasic material, much decomposed. Their specific gravity is 3, and the abundance of viridite present causes them to possess a greenish colour.

Very few similar occurrences have been notified in New South Wales.

Mr. J. E. Carne, F.G.S., Geological Surveyor, has described† a nodular felsite from Pambula. In this case, however, the nodules appear to be simply segregations of the felsite magma itself.

* Both Mr. G. W. Card, A.R.S.M., and Mr. W. S. Woolnough, B.Sc., agree in referring this mineral to the amphiboles.

† Annual Report of the Department of Mines and Agriculture for 1896, page 111.

The Pennant Hills basalt quarry contains numerous rounded pieces of an ultrabasic rock, containing chromite or picotite, olivine and magnetite, and representing probably a variety of dunite. Professor T. W. E. David, of Sydney University, suggests that the basic magma in its upward progress caught up fragments of an ultrabasic rock, and subsequently corroded the fragments so caught up, till they presented the appearance of sub-ellipsoidal masses.

A similar origin may probably be assigned to the Eleanora "pebbles," but whereas in the Pennant Hills pipe the magma is basic (olivine-basalt), in the Hillgrove case the magma is an acid rock, or one belonging to the upper or acid end of the intermediate group. Mr. W. S. Woolnough, B.Sc., of Sydney University, suggests that, owing to the acid nature of the magma, there should exist a zone of intermediate composition between the nodules and the dyke matter proper.

Mr. E. F. Pittman, Government Geologist, mentions the occurrence at Lucknow of rounded masses of augite andesite at or near the junction of huge masses of andesite and serpentine. The augite andesite blocks are completely enveloped by the serpentine.

6. LIFE OF THE REEFS AT THE LOWER LEVELS.

(1.) Granite generally occurs as bosses, *i.e.*, more or less dome-shaped masses, with the broader portions as bases.

(2.) The granite bosses of Hillgrove have a very slight inclination from the vertical, as shown in diagrams elsewhere.

(3.) The fine-grained intrusive granite near the Sunlight Reef and the Baker's Creek properties appears to be almost vertical in slope.

(4.) The slate belt is excessively narrow where the gold occurs.

(5.) The granite almost abuts on some of the reef lines.

(6.) The *main* granitic mass of the field does not appear to cut off the lodes, and actually carries some, *e.g.*, the Eleanora and Freehold Reefs, continued into the granite. The Hopetoun, Starlight, Centennial, Carrington, and Cosmopolitan lodes are contained wholly in the granite.

(7.) The last and finest granite of the field appears only as a destroyer, and not a maker, of gold reefs, and cuts across the strike of the Little, Big, and Baalgammon lines of reef at a short distance from the creek.

It therefore seems useless to spend time and money in the exploitation of the country to the north-west of the Baker's Creek property. As to the Baker's Creek property lines of reef, dipping away as they do from the fine-grained granite, and towards the reef-forming granite mass to the north, it seems unnecessary to make any comment. A reference to the general section will illustrate their position with respect to the fine-grained granite mass.

The Sunlight varies in distance from 60 to 200 yards from the fine-grained granite, and dips towards it. A reference to the plan of the field will show its approximate parallelism of strike to that of the granite and slate junction close by. The granite, however, as observed in No. 5 tunnel, and at the surface, has very little inclination towards the reef, and therefore may not affect it for a great depth, except as a little crushing and by faulting, and this only at its eastern end.

The Eleanora appears to be derived from the main granitic mass close by, and no other igneous rock, except the dyke, is close at hand. It may also be noticed that only in the vicinity of the main granitic mass are the reefs

payable, none of the reefs being traced into or to the neighbourhood of the greenish granite to the south. It must be remembered that much of the granite to the south of the Sunlight is of the same character as that of the main mass, its exact line of junction with the greener rock not being ascertained.

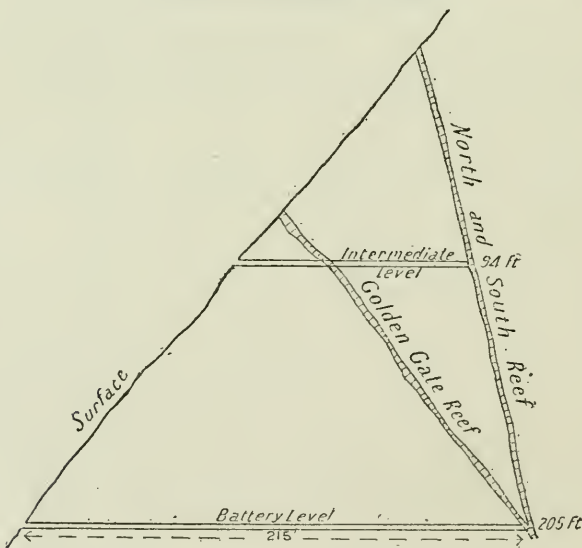
7. DESCRIPTIONS OF MINING PROPERTIES.

The order selected in this description of reefs and properties is not intended to be at all indicative of the proportionate value of the properties enumerated, *e.g.*, the most valuable block on the ground is that of Baker's Creek Company, which is described in the closing pages.

(a) THE GOLDEN GATE REEFS.

These reefs were worked first for antimony (?). Up till seven years since they were held by different parties, and eventually fell into W. Miller's hands. Thomas Snow, of Hillgrove, took them then on tribute from Miller, who resided at Armidale. It afterwards passed into the hands of the Australasian United Exploration Co. This was in February, 1897. At that date it was by them amalgamated into the Hillgrove Proprietary Mining Property, Ltd. In April, 1898, the Cooney Proprietary Co. amalgamated with the latter, and as such it remains. For this information I am indebted to Mr. H. M. Porter, Manager for the Cooney Proprietary Co.

Sketch illustrating method of working the "Golden Gate" and "North and South" Reefs.



Two reefs run through this property, *viz.*, the Golden Gate Reef and the North and South Reef. The ore has been won from these by tunnels driven into them from the hill side. The strike is approximately N.-W., but it varies very much owing to numerous faultings and crushings. It underlays steeply to the east. The Golden Gate Reef itself underlays 35 feet in 100 feet vertical descent; in 205 feet it underlays 94 feet.

The Golden Gate and North and South Reefs intersect at a distance of 215 feet from the mouth of the tunnel, and 205 feet below the open cut of the North and South Reef. According to Mr. Thomas Snow, this carried 2 ounces of gold to the ton. Underhand stoping has been carried on for 40 feet below this level.

The new company did a little work here in September, 1897. A winze was sunk 197 feet 6 inches from the tunnel on the top into the North and South Reef to the bottom level of the Golden Gate.

At the intermediate level the cross course was driven on, and the south wall was stripped for a distance of 66 feet, but no reef was exposed. The Golden Gate Reef was lost for a time owing to the intersection of three or four cross courses.

Through the courtesy of Mr. Thomas Snow, formerly manager of this property, the following returns are published here. The crushings were performed on the spot with a 10-head battery.

From the east reef, known as the Golden Gate Reef, the top level yielded 1,000 oz. of gold for 1,500 tons of ore crushed.

From the lower level 600 tons were crushed for a yield of 900 oz. gold, and from the North and South Reef, 1,000 tons were crushed for 200 oz. of gold.

Total, 2,200 tons for 2,100 oz. of gold.

(b) THE PROPRIETARY'S CLAIMS.

These consist of various properties, viz., the lower and upper Cooney tunnels, the rise into Baker's Creek No. 3 level, and extension also of the same. (*Vide* diagram.)

The workings performed by the old Baker's Creek Co. are all connected by means of the main Cooney tunnel.

This fine tunnel starts from the northern boundary of M.T. 11, about 2 chains from Baker's Creek. Its course is straight and is N. 23° 18' E. Up till 1st April it had been driven into the hill 2,054 feet. It is about 8 feet high and 8 feet wide. This was a portion of the property held by the late Baker's Creek South, which company abandoned the ground some years ago after driving some 300 feet into the hill. It then lay idle until a local syndicate, known as Baker's Creek No. 1 Extended, applied for a tunnel site to enable them to prospect the blocks lying to the south of the Baker's Creek Mine. This syndicate cut the tunnel down, making it wider, and extending it for a further distance of 100 feet. The total distance driven till then was 405 feet. Then the United Australian Exploration Co. purchased the ground held by the syndicate, and since that time the company have continuously extended the tunnel. It was proposed to drive the tunnel a distance of 2,000 feet into the hill and then pick up the Golden Gate Reefs.

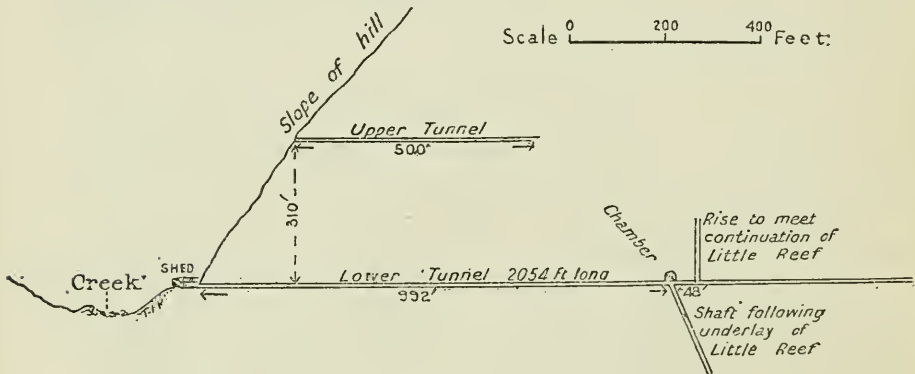
In driving the tunnel a number of veins had been cut, as many as seventeen different ones being struck between the 992 and 1,671 ft. marks. A shaft is being sunk on the first one met with, supposed to be the "Little" Reef. As five others have been cut close to it, it is doubtful which will be the prize—to wit, the "Little" Reef. This is at a distance of 992 feet from the mouth of the tunnel, where a chamber has been cut out to allow of hauling gear to be set up. The shaft is a main underlay one, and is being carried down at a uniform angle of 72° 30'. The system of timbering adopted is that known as the "Colorado"—usually employed in America. It consists of heavy timbers or main sets following the underlay, and all cross-pieces are set normally to the underlay also, so as to overcome side thrusts from the walls

The platforms in the ladder-way are also normal to the shaft walls, and ladders are attached to the footwall. This is also known as the "square-set" system.

At 1,040 feet from the entrance, a rise was put up 138 feet, and connected with the extension of No. 3 level of Baker's Creek workings along the "Little" Reef. This extension of No. 3 level consists of a zigzag system of crosscuts to pick up the southern continuation of the reef. It is very possible that the reef was lost all this time. (*Vide* diagram.)

The upper Cooney tunnel is in portion 182. It was driven 500 feet in a direction N. 44° E., and it lies 310 feet above the lower tunnel. It was driven by the Baker's Creek South Co. The present proprietors have driven 162 feet on a vein at a distance of 400 feet from the entrance. The diagram explains the relative positions of the workings.

Section across Proprietary tunnels. Both tunnels are projected into one plane. The direction of the Lower Tunnel is approximately at right angles to the strike of the "Little" Reef.



The Proprietary Company, being possessed of an enormous capital, are determined to save no expense in establishing a proper mining plant on the field. An air compressor is in use which, by compressing air to the extent of 80 lb. to the square inch, and working at 80 lb. pressure, can keep six to eight rock drills at work. The air is conveyed down the gorge by a straight cast-iron pipe, 5 inches in diameter, 2,308 feet in length to the mouth of the tunnel, and 2,000 feet along the tunnel itself. The difference of altitude between the engine and tunnel is 1,500 feet. The piping on the hillside (2,308 feet long) is provided with eight expansion pieces, each of which working on a sleeve is allowed a slide of 17 inches. The gorge is subject to extreme variations in temperature. An extreme movement of 7 inches has been noted on one sleeve. Six rock drills are used by the Company; three "Nationals," two "Ingersolls," and one "Little Giant." With a "National," one hole 5 inches deep was bored in twenty-two minutes in the slate. It may be noted in passing that certain bands in the slate of this field are extremely difficult to pierce. A banded, dark black, or a curly grey slate gives the most trouble. According to Mr. H. M. Porter, some of it nearly approaches the topaz rock of the Emmaville emerald mines in hardness. Of the machine drills, the National is probably the most serviceable on the field. The Ingersoll appears to work a little more speedily, but the

chuck attachment for holding the drills is not so good, too much time being occupied in changing the drills, and this part of the machine is frequently in need of repair.

Shots are being fired simultaneously by electricity, although the occurrence of stray defective fulminating caps causes annoyance. The Company intends laying a tramline down the hillside at an early date.

(c) THE HOPETOUN REEFS.

The property containing these reefs was taken up by a company of 100,000 £1 shares. It was known at first as the "Root Hog." Afterwards, various names, such as the Earl of Hopetoun and Lady Hopetoun, were given to different portions of the property. At present all the blocks constituting the old gold leases have been amalgamated into one property--The New England Scheelite Property.

The workings on the reefs are confined solely to the coarse granite area. The reefs approximate closely in both strike and dip to the more important lodes of the Hillgrove Gold-field. Of recent years the gold of the reefs has been found to give place, in patches, to masses of scheelite. In the upper portions of Nos. 1 and 2 lodes the scheelite was of very good quality. Mr. Fuller, of Hillgrove, informs me that at a depth of 300 feet below the surface a large body of low-grade lime tungstate has been exposed, in places as much as 3 feet wide.

Both gold and scheelite have been won by means of tunnels driven into the hillside.

No. 1 tunnel, 20 feet above the creek, bears 15° north of west and is 1,176 feet long. About 400 feet from the mouth of the tunnel No. 2 reef was cut. This has a strike of 35° north of west, and is thrown some 5 feet to the south by a cross course near the point of intersection with the tunnel.

A little further along Nos. 1 and 2 reefs have been stoped for a width of 20 feet, a height of about 50 feet, and a length of 60 feet. In the chamber so formed machinery was set up for the sinking of a main underlay shaft. At a depth of 30 feet the sinking was abandoned. No. 2 tunnel, 110 feet above the creek, cuts No. 2 reef some 50 feet from its mouth. The bearing of the reef here is 36° north of west. Here, also, a cross course has thrown the reef some 6 feet to the south.

No. 3 tunnel is driven on Nos. 1 and 2 lodes at a height of 170 feet above the creek bed. No. 4 tunnel is also driven on these lodes at a height of 220 feet above the creek.

Another vein, known as No. 3 lode, lies a little to the south of Nos. 1 and 2 lodes. Nos. 2 and 3 reefs are 15 feet apart in No. 2 level. The general dip of the reefs is north-east at 80°.

The early gold returns of this mine were supplied by Mr. S. Sullings, of Hillgrove.

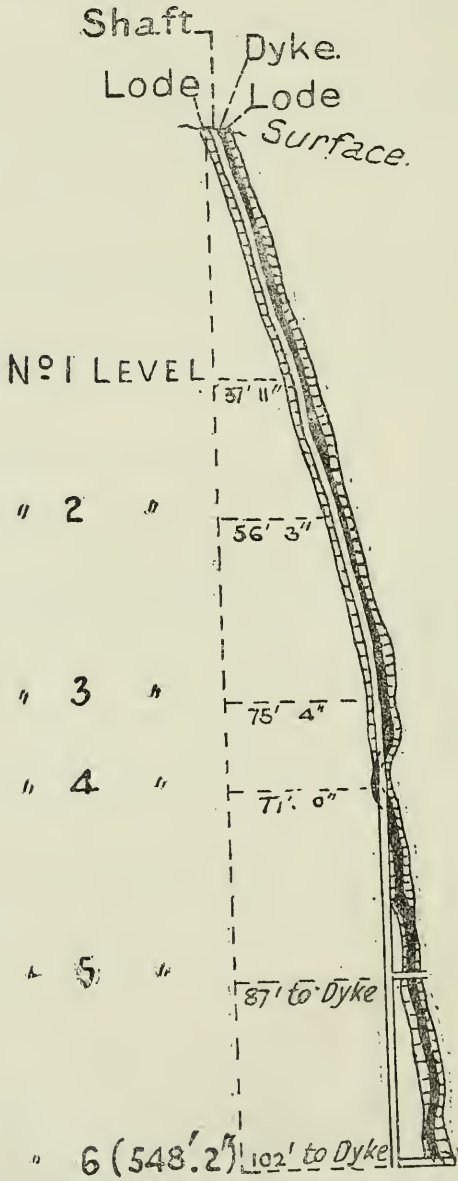
The first four crushings yielded respectively 500, 400, 300, and 200 oz. of smelted gold.

(d) THE ELEANORA REEF.

The history of this mine has been outlined in the earlier pages of the report. Messrs. Brackin, Daly, and Elliot, having found the Eleanora in 1878, put in a claim for the Government reward offered for discovery of a payable mineral lode. At that time it was believed to contain antimony only. Reconstruction has been resorted to several times. The returns since 1890 show when reconstruction has taken place since that date.

Section across lode, dyke, and shaft in southern (shaft) end of Eleanora Mine.

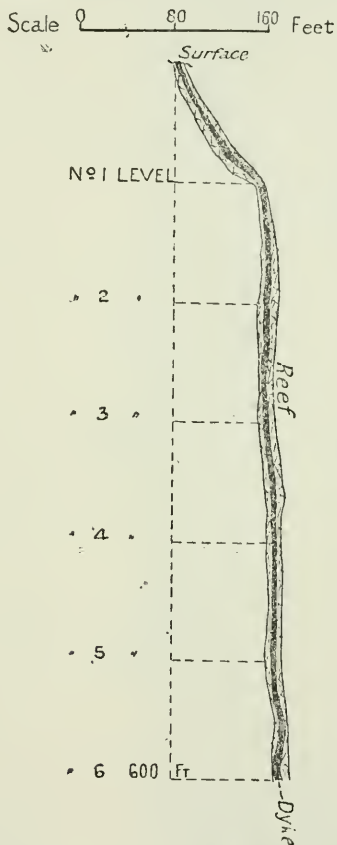
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Between No. 6 and No. 5 levels and between No. 5 and No. 4 levels the dyke is bent, and the lode appears to sit on the bulged-out portion.

The Eleanora Reef, as also its southern extension, known as the Garibaldi, runs for the greater part of its length along the flat land at the top of the Baker's Creek gorge. It is the only important line of reef in the area that practically lies above the gully. Towards its northern end it runs diagonally along the face of the gorge till it passes into the coarse granite. Southwards it is continued over the point of the Garibaldi Spur, but does not appear to last as far as the greenish granite mass lying in that direction. Its strike is north-west and south-east approximately, and it possesses an underlay of

Section across Eleanora Reef towards Northern Boundary.



A brecciated slate lode, with white or transparent quartz cementing, heavily charged with arsenical pyrites, and containing vughs full of beautiful stibnite crystals. It is a huge low grade ore, as much as 23 feet wide in places. A metamorphosed granitic dyke occupies the central portion of the lode.

about 1 in 5 towards the north-east. If the Cosmopolitan Reefs are simply continuations of the Eleanora Reef, as appears probable, not only from their line of strike, &c., but quality of stone, as far as antimony is concerned, then this line of reef stands proven over one and a half miles of country. A granitic dyke, much altered, follows the lode along the greater part of its course, occupying the central portion of the lode.

The country traversed is, for the most part, a slate, altered into a knotted schist. Numerous vughs occur throughout the lode, filled in places with magnificent stibnite crystals.

The returns show this reef to be a huge low-grade ore deposit. In places the stone is, with the included dyke, 22 feet wide. (*Vide* sketch of reef on page 20.)

At first tunnels were driven on the lode from the side of the gorge. No. 4 is the lowest tunnel so driven. On the lip of the fall a whip-shaft was sunk on the reef. Afterwards the north shaft was put down to No. 4 level. This is an underlay shaft, and necessarily, as will be seen from sections of the lode, involves great strain on the hauling ropes. A south shaft was afterwards sunk, 200 yards from the north one, and at the No. 4 level both shafts were connected by a zigzag drive, which was generally carried along the reef. At the southern shaft the reef has been worked on both sides of the dyke, here about 4 feet wide. At times the total width of reef and dyke at this level is 10 feet. These shafts were then sunk vertically to No. 6 level. The south shaft is being carried down another 100 feet.* A reference to the vertical section of the Eleanora will show the amount of stopping performed in this mine (Plate XI).

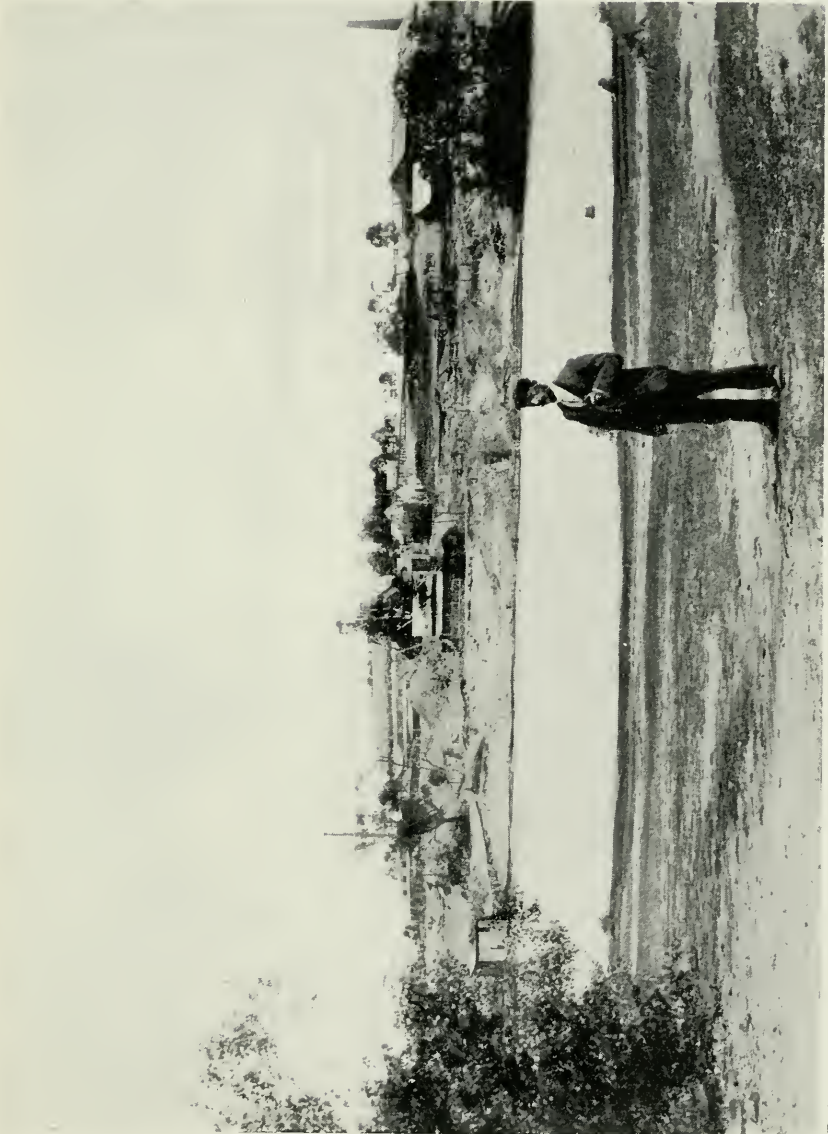
No gold returns were obtained before June, 1892, but since that date they are as follows :—

Date.	Tons crushed.	Smelted Gold.			Antimony, &c.
		oz.	dwt.	grs.	
July to 31st December, 1892.....	2,595	1,998	13	15	77½ tons crude antimony. 13½ tons metal antimony.
January to 30th June, 1893	3,006	1,638	9	12	
July to 30th December, 1893.....	3,095	1,524	12	0	157 tons crude antimony. 212 tons crude antimony.
January to 30th June, 1894.....	3,152	1,133	0	0	227 tons crude antimony. 86 tons concentrates.
July to 30th December, 1894.....	6,093	2,261	5	0	
January to 30th June, 1895... ..	5,897	879	6	0	213 tons crude antimony. 88½ tons concentrates. 979 tons crude antimony. 37 tons metal antimony. 131 tons concentrates.
July to 30th December, 1895.....	6,305	2,010	6	0	
January to 30th June, 1896.....	6,606	3,559	18	0	186½ tons concentrates. 96½ tons crude antimony. 9½ tons metal antimony.
July to 30th December, 1896.....	6,847	4,696	7	0	
January to 30th June, 1897.....	6,230	2,596	7	0	231 tons concentrates. 211½ tons concentrates. 9½ tons crude antimony. 11½ tons metal antimony.
July to 30th December, 1897.....	6,180	2,826	1	0	
January to 30th June, 1898.. ..	1,879½	834	11	0	278 tons concentrates. 298 tons concentrates. 5½ tons crude antimony. 13½ tons metal antimony. 138 tons concentrates.
July to 30th December, 1898.....	6,260½	2,674	8	0	
January to December, 1899.....	220	104	11	0	3½ tons crude antimony. 1½ tons metal antimony. 230 tons concentrates. 270 tons concentrates.
	10,195	2,939	16	0		14½ tons oxidised antimony.

* The Eleanora has since been shut down.

The calcined concentrates yielded on an average 3 oz. 10 dwt. per ton, with a value of £3 10s. per oz.

The antimony oxide brought £16 10s. per ton on the field.



To face page 32.

ELEANORA PLANT AND DAM, FROM THE EAST.

Machinery.—The Eleanora workings supply a 70-head battery. A tram-line some 200 or 300 yards in length (Plate V) connects the north shaft with the battery. The average weight of the stamps is 760 lb., with a drop of 9 inches, and an average working speed of eighty-five drops per minute. The method hitherto adopted has been to pass the crushed material over blankets, but copper plates are very shortly to be substituted. At present the battery contains 2,110 square feet of blankets and only 30 feet of copper plates. Nine "Berdans" are used for amalgamating. There are also two Arastras, and thirteen Frue vanners. The crushing efficiency of each stamp is 23 cwt. daily. The amount of calcined concentrates produced per day is $1\frac{1}{2}$ ton. About 200 men are employed in this mine.

(e) THE GARIBALDI PROPERTY.

This line of reef is the south-east extension of the Eleanora or Isabella line of reef. As with the Eleanora, it was first worked for antimony and afterwards for gold.

In places two reefs, or two branches of the one reef, appear to have been worked. These lines are 20 feet apart. Two vertical shafts have been sunk, of which No. 2 shaft is 240 feet deep. From the shafts the lodes have been worked by crosscutting. There are three levels, viz., the 100, 140, and 240 feet levels.

The 100-foot level on one line of reef west of shaft has been driven 90 feet, and to the east has been taken 100 feet. The direction of this level is 5° south of east.

The 140-foot level is 190 feet in length, and is almost directly under the 100-foot level.

The 240-foot level has been reached by crosscutting 50 feet from the shaft. According to the plan of the workings the two reefs met with at the surface make into one at the 140-foot level.

The sections across the Eleanora Reef will answer equally well for the general features of the Garibaldi Lode, the dyke accompanying the central portion of the lode.

Twenty head of stamps were used in crushing the ore.

(f) THE COSMOPOLITAN REEFS.

This property was originally taken up as the North and South Cosmopolitans. It consists of two reefs trending in a north-west direction and cut across by an east and west gully, which divides the North from the South Cosmopolitan. The reefs lie wholly in the coarse granite (granitite) of the field, and are held by the miners to be the northern continuation of the Eleanora Lode. There seems much to favour this idea, since sighting along the strike of the Eleanora as it makes down the gully, brings the hairline of the compass in line with the direction of the Cosmopolitan tunnels. The lode, however, has not been proved along the whole of this distance, an unproven patch of several hundred yards in length occurring to the south of the South Cosmopolitan. The talus of the hill slope may simply have obscured any possible outcrop however.

These lodes were pegged out in the same year as the Baker's Creek Reefs, and, though originally worked for gold, were subsequently exploited for antimony. The workings consist of several tunnels driven into the hill on the reef. These tunnels are 100 feet below each other. The lowest is 70 yards

in length, driven in a north-west direction. The one immediately above is some 50 yards long, also driven in a north-west direction. The ore was brought to the tunnel-mouths and carried by tram up the sides of the hill. The underlay is to the north-east.

The South Cosmopolitans consist of tunnels driven in more than 100 feet into the hill. A heave has thrown one of these reefs 12 feet.

Many large parcels of antimony have been sent from this mine, one yielding 100 tons of metal.

From the Old and New Cosmopolitan Companies gold was obtained to the value of £31. From the "Old Cosmopolitan" £547 worth of antimony was extracted, and from the "New Cosmopolitan" £350 worth of the same metal was obtained.

(g) CARRINGTON LINE OF REEF.

This is also thought by some to lie on the Eleanora line of reef, between the latter and the Cosmopolitans. The reef lies wholly in the coarse granite, and has produced much gold and antimony. Tunnels have been driven on the reefs. Formerly a large battery was in full working order on this side, while a fine dam for the conservation of water was constructed on the top of the falls 800 feet above the mine.

In 1886 this property was prospected by Mr. Thomas Snow, of Hillgrove. Tributors last year crushed 15 tons of stone for 31 ounces of gold.

(h) THE SUNLIGHT REEF.

The surface line of this reef is bold, and runs diagonally across the west side of the Baker's Creek gorge. (Plate VI.) The open cut is some 400 to 500 feet directly above the battery, while towards the West Sunlight it is 700 feet above the bed of the creek.

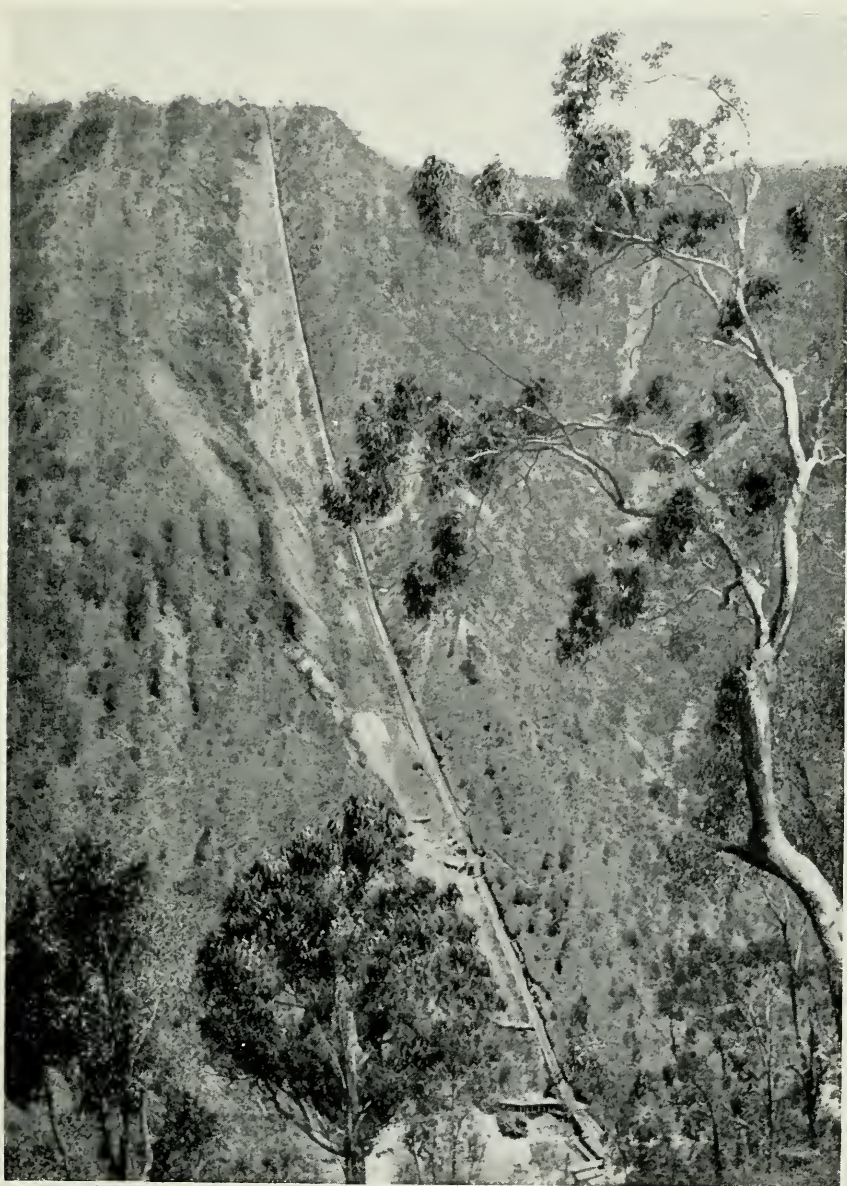
This property was first taken up by Moore, Speare, and Company about the year 1878 for antimony. Since that time the property has passed into various hands.

The general direction of the lode is 25° north of west. It runs fairly parallel to the outcrop of the latest granitic intrusion. The country is of slate and schist, much contorted and broken up by crushings and series of small faultings. The dip is about 1 in 5 in an easterly direction. The walls are better defined here than in the other reefs of the field. Magnificent crystals of stibnite (antimony sulphide) are found in vughs. From the surface to the No. 5 level the exploitation of the mine was carried on by means of short tunnels driven in from the hillsides. As the underlay is toward the creek, and the sides of the gorge are very steep, this method of winning the ore was comparatively easy.

No. 5 tunnel was driven in about 30 feet above the bed of the creek, and cut the reef 411 feet in the hill. No. 4 tunnel caught the reef at 240 feet, No. 3 at 70 feet, while the higher ones had tunnels driven on the lodes.

Short shafts were also sunk from the surface into the different levels.

On the No. 5 level the lode was worked east and west of the point at which the tunnel cut the reef. 500 feet along the lode in the western extension an underlay shaft was sunk, and from this Nos. 6, 7, and 8 levels are worked. The latter level is about 250 feet below the creek bed. The vertical section supplied shows the method of working the reef, and also the proximity of the granite along No. 5 tunnel. It must be remembered, however, that the large gold shoot of the reef is at some distance from the granite.



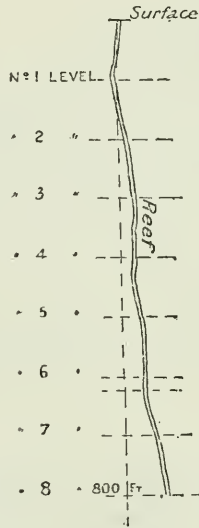
To face page 34.

SUNLIGHT TRAMWAY, SEEN FROM THE COONEY TUNNEL.

No plan is supplied of the stopings of this mine, but it may be interesting to know that most of the reef has been won in the western end as far down as the 7th level (800 feet). The stone has been much crushed in this lode, and huge masses continually threaten to fall during the progress of overhand stoping. From No. 7 to No. 6 level the reef is being won by stoping in a diagonal direction.

Sunlight Reef.—Section at western end.

Scale 0. 160 .320 Feet



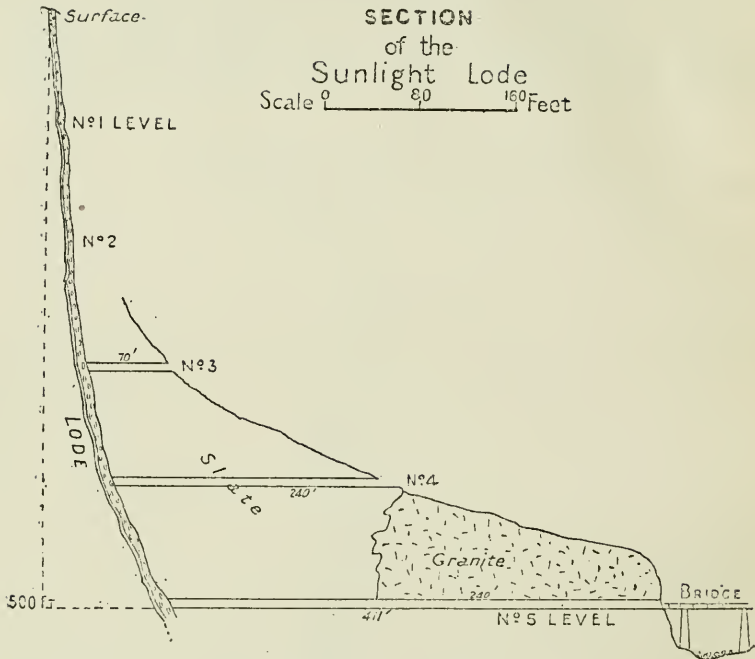
Down to No. 5 level the ore has been won by tunnels and a series of short shafts on the hillside. 950 feet along the No. 5 tunnel and drive an underlay shaft has been sunk on the lode.

At the eastern end the lode has been much faulted, but no trouble has been exercised to pick it up, as the stone is of inferior quality. Still, much of the reef has been extracted as low down as No. 5 level. In all, five shoots of stone are said to exist in the mine, each of which is more or less vertical.

No returns of the Sunlight Mine were available before 1892. From that date onward they are as follows :—

Date.	Tons crushed.	Ounces Smelted Gold.
1892)		oz. dwt. grs.
1893 {	7,820	4,029 1 0
January to December 30th, 1894 (partial return).....	3,459	667 10 0
January to December 30th—		1,337 3 0
1895	10,688	4,838 12 0
1896	13,248	7,927 12 0
1897	11,248	5,326 12 0
1898	10,997	4,598 9 0
1899	9,567	4,722 5 0

Sunlight Lode.



The lode is quartz and slate breccia, containing much antimony and arsenical pyrites. The lode has been reopened, and the later fissure filled with crushed slate. This disturbance seems traceable to the intrusion of the fine granite at A. The proximity of the granite to the lode will at once be observed. The plan represents the projection of the tunnels on to one vertical plane.

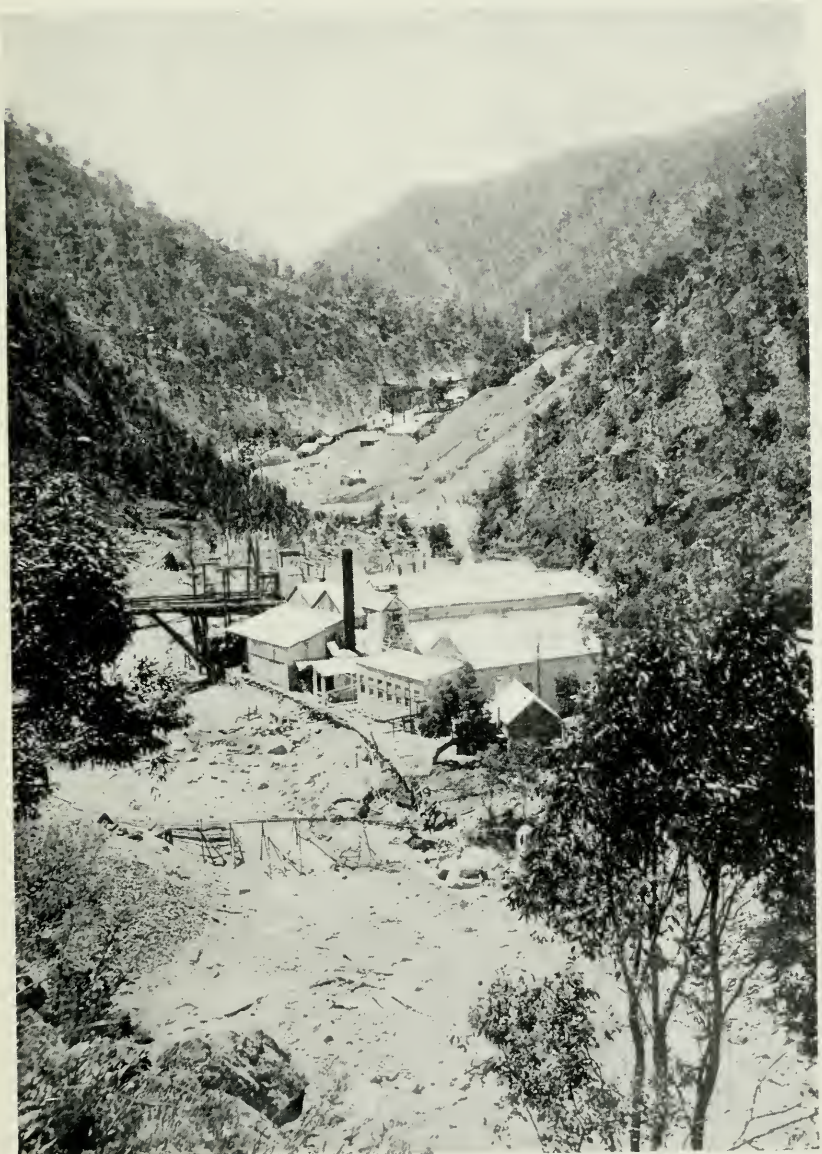
Total amount of quartz crushed from 1st January, 1892, to 30th December, 1899, is 75,085 tons for a yield of 36,873 oz. 6 dwt. 12 grs. of smelted gold.

The machinery consists of forty head of stampers, each averaging some 650 lbs. in weight. These, with a fall of 8 inches, working up to seventy-five blows per minute, assisted by a Blake-Marsden type of rock-breaker, and with automatic feeders, gives a result of 430 to 500 tons crushed per fortnight, or an average working efficiency for each stamp of 18 to 20 cwt. per day. The crushed ore passes from the stampers over 16 feet of copper plates, and the thick pulp from the settling boxes is placed on Frue vanners, each of which is served by five head of stampers.

The mine is lighted by electricity, and the lower levels of the mine were also, until very recently, worked by an electric plant stationed at the top of the main shaft in No. 5 level.

(i) WEST SUNLIGHT MINE.

The work done by this Company consists in the exploitation of the north-west continuation of the Sunlight line of reef. Two reefs were worked, the Magazine and the West Sunlight or Main Reef. The strike of the reef at the boundary between the Sunlight and West Sunlight properties is 20° north of west, and the lode has been proved for 800 feet in this direction. Traces of it exist in the rough country to the north-west, but no payable prospects have been obtained.

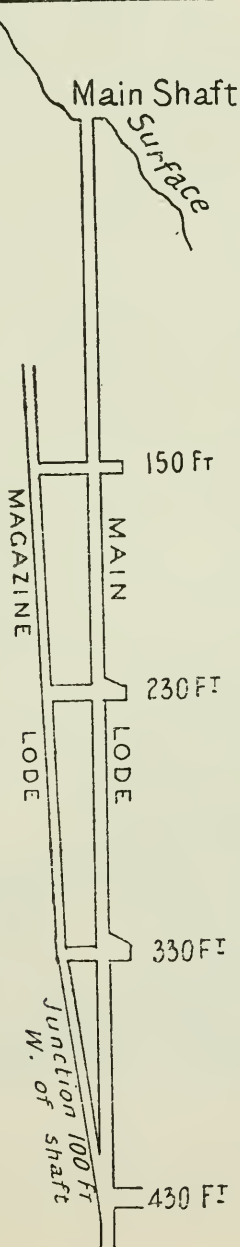


To face page 36.

SUNLIGHT BATTERY, WITH CONSOLS AND BAKER'S CREEK WORKINGS IN THE MIDDLE GROUND.

Section across Magazine and Main Lodes of the West Sunlight Property, showing the bifurcation of main lode at 430-foot level, and the method of winning the ore from the Magazine lode.

Scale 0 50 100 Feet



The Magazine and Main Reefs were worked simultaneously from a main shaft, crosscuts being driven from the main line to work the Magazine Reef. At the 430-foot level the two reefs made into one. In all ten levels have been driven. No complete plan of the workings was obtainable. The cross-section shows the relative position of the two reefs, and the methods adopted for winning the ore. A good deal of stoping has been done, particularly between the surface and No. 5 level. Mining operations have been at a standstill during the past half-year (July to December, 1899). McNamara and Party expect to resume work early this year.

The following gold returns of the mine between January, 1894, and June, 1899, were supplied by Mr. McNamara, of Metz:—

Date.	Tons crushed.	Ounces Smelted Gold.	
		oz.	dwt.
January to June, 1894	4,614	2,546	19
July to December, 1894	4,913	2,479	13
January to June, 1895	3,792	1,659	10
October to December, 1895*	2,064	795	16
January to June, 1896	3,621	1,541	6
July to December, 1896	3,949	2,019	8
January to June, 1897	3,419	1,660	18
July to December, 1897	3,773	2,441	3
January to June, 1898	4,646	1,900	12
July to December, 1898	3,835	1,204	19
January to June, 1899	2,082	750	7

* Mine closed July to October, 1895, owing to want of water.

In 1898, 119 tons 13 cwt. of concentrates were treated for 583 oz. 12 dwt. of gold. Twenty head of stampers were in use, each stamper weighing about 900 lb.

(j) BAKER'S CREEK REEFS.

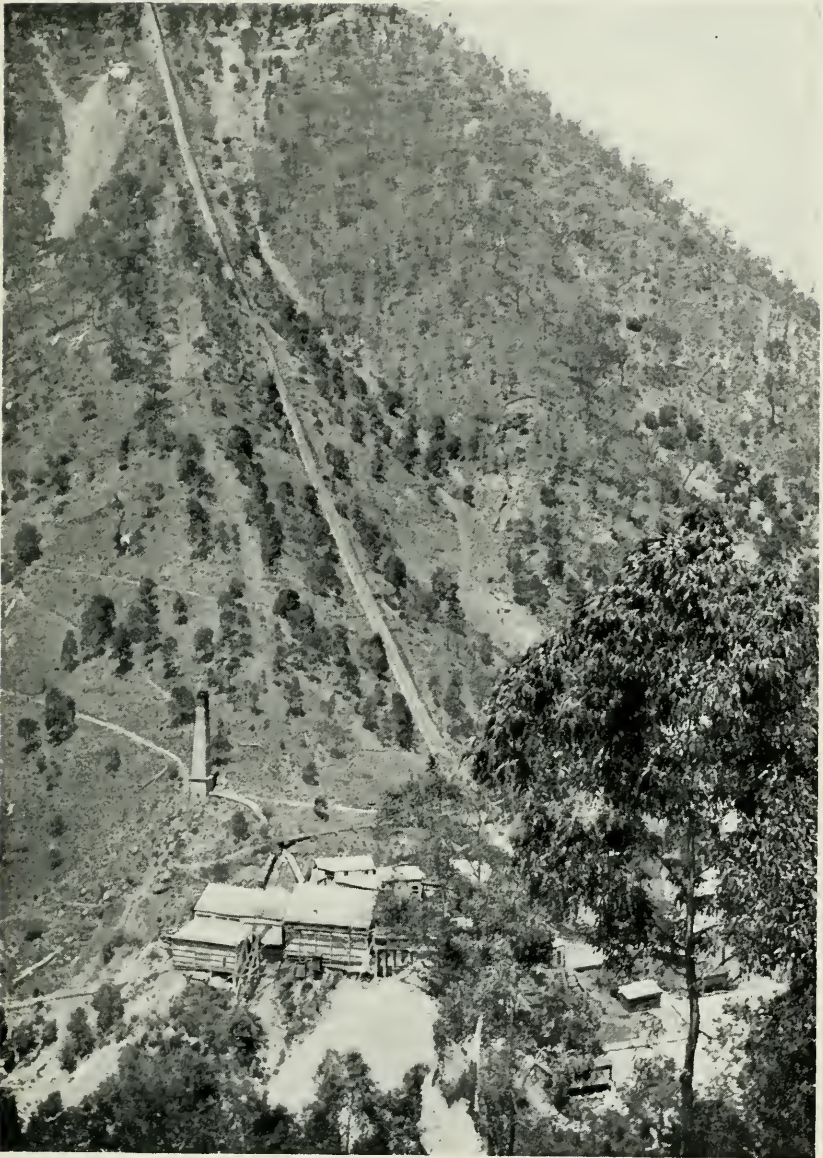
Baker's Creek property includes the most valuable portions of the Little Reef, the Big Reef, the Middle Reef, and Hill's Reef. These are situate in the lower portion of the eastern side of the gorge. By a mere accident the Little Reef was included in the area pegged out for the Big Reef, and as it underlay into the portion, the wealth of the property was assured. Since the initiation of mining operations on this property the Company holding it have regularly paid dividends.

The general trends of the reefs are as follows:—

The Little Reef	...	...	N. 55° W.	
The Big Reef	...	...	N. 50° W.	All dip easterly
Hill's Reef	...	...	N. 30° W.	at about 75.°
The Middle Reef	...	...	N. 65° W.	

The Big Reef outcropped strongly in one or two places at the surface, showing a body of stone 4 feet wide. But for some distance down it contained very little gold, and much of it in the higher levels was never stoped.

The Little Reef is marked in places by its thread or "stringer"-like appearance, and its lack of well-defined walls. The payable part of the lode in the Little Reef is confined to a steep shoot of stone. According to the underground managers, this has been worked from the No. 3 level to the lowest point yet attained in the mine, viz., the 13th level. In a straight line No. 1 cross-course is about 120 feet distant from the main shaft, while No. 2 cross-course is generally some 200 feet nearer the southern boundary. The



To face page 28.

BAKER'S CREEK TRAMWAY, FROM PETERSEN'S SHAFT.

north-west boundary of the shoot is close to No. 1 cross-course. The best gold in the upper levels was contained between the two cross-courses. At No. 7 level the gold was found thickly scattered about in No. 1 cross course; thence downwards it was obtained further to the south, and the shoot possessed a steep angle of dip. At No. 9 level the southern extension of the shoot was 53 feet from the end of the drive, 112 feet from No. 2 cross-course, and 418 feet from No. 1 cross-course. The shoot at this level was 40 feet wide.

At No. 10 level the southern boundary of the shoot was 40 feet from the end of the drive (more than 60 feet from boundary). The shoot itself was 40 feet wide, and was 163 feet from No. 2 cross-course.

Similar results were obtained in Nos. 11 and 12 levels. At No. 12 the southern boundary of the shoot was 90 feet from the southern boundary of the property.

The ore was won in the early days of the field by open cuts along the out-crops of the reefs. Good work was hampered considerably by the amount of surface debris (*see* longitudinal section, Plates XII and XIII), which at times amounted to as much as 50 feet in thickness. No. 4 tunnel was driven in on the reef near the bed of the creek. At the mouth of No. 3 level, a main shaft was sunk, and from this most of the reef has been worked. The shaft follows the reef to No. 6 level, and thence to No. 13 the ore has been won by cross-cutting from the shaft, which latter, though not vertical, does not follow the reef. The Big Reef has been worked below No. 3 level by cross-cutting from the corresponding levels on the Little Reef, on No. 1 cross-course. (*See* section across Big and Little Reefs, Plate XIV).

A shaft was put down to the north of the main one (at the entrance to No. 3 level), and levels at 125 and 225 feet respectively were driven along the Little Reef. The 225 feet level is nearly on a level with No. 6 in the main workings.

One of the difficulties in working the Little Reef is the apparent insignificance of the vein. Frequently it traverses the dense blue slate country as a mere ribbon, and unremunerative veins setting out from it frequently make into strong reefs up to 12 inches or 18 inches wide. Another is the difficulty attendant on working the "kicking" ground along certain levels. Certain parts of the reef, notably at No. 11 level, are unstoped, as the risk to the men's lives working the ground is considered too great to continue the work.

A tramway has been laid down from the top to within 50 feet of the bottom of the gorge (Plate VIII). Its course is perfectly straight, and the line itself is triple, with a central loop. Sleepers are fitted into the slope of the hill some 2 feet apart. The length of the line is 2,660 feet; the vertical descent is 1,407 feet, and the steepest angle of slope 43 degrees. An endless rope, $\frac{7}{8}$ -inch in diameter, and 3,000 feet long, is in use for hauling the trucks. Its breaking strain is 22 tons, and its usual load, including the truck, never exceeds two tons. Formerly the men were compelled to walk up and down the hill-side to their work, but for some years past now the trucks have been utilised partly for this purpose. The men subscribe a certain proportion of their wages to an accident fund, and in case of a mishap, the injured ones receive attendance at the local hospital, and certain pecuniary assistance while incapacitated for work.

Machinery.—The company owns a fairly complete plant for crushing ore. The battery consists of 40 head of stampers, each averaging some 6 cwt., and having a fall of 6 or 7 inches. Their working speed is ninety to ninety-five blows per minute. Automatic feeders are in use, but the ore is broken up small enough in the stopes to dispense with a rock-breaker. Each stamper serves 7 feet of copper plates, and 20 feet of blankets per medium of slotted

screens; four Woodbury vanners and two large Berdan pans, each 4 feet in diameter, save the concentrates. About 500 tons of stone are put through every fortnight, each stamp thus possessing a working efficiency of 18 cwt. per day. The shoes of the stampers, as well as other rough ironwork, are cast on the premises.

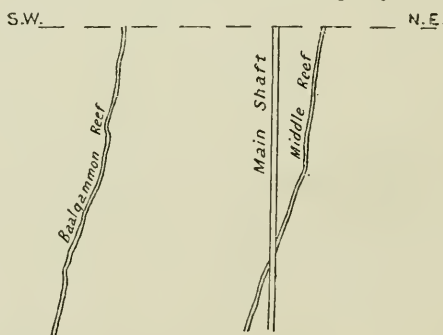
The following are the returns for the Baker's Creek Mine, with a few exceptions, from 1887, the year of discovery, up till the present:—

Date.	Tons of stone crushed.	Ounces of smelted gold.
		oz. dwt.
November 12th—December 24th, 1887	63	700 0
May 9th—December 27th, 1888	766	8,959 0
January 21st—June 29th, 1889	1,307	17,293 0
January 31st—June 28th, 1890	2,613	5,836 10
July 7th—December 31st, 1890	3,111	5,639 0
January 30th—June 30th, 1891	3,005	7,575 16
July 17th—December 24th, 1891... ..	3,121	10,500 0
February 26th—June 30th, 1892... ..	3,996	6,975 0
July 15th—December 23rd, 1892... ..	4,551	11,564 8
January 24th—June 30th, 1893	4,779	9,748 12
July 15th—December 23rd, 1893... ..	4,958	10,337 12
January 18th—July 10th, 1894	5,251	8,675 16
July 14th—December 23rd, 1894... ..	5,677	8,918 12
January 26th—June 29th, 1895	6,710	8,194 2
July 13th—December 24th, 1895... ..	7,048	7,610 11
January 25th—June 30th, 1896	7,741	7,238 18
July 10th—December 30th, 1896... ..	5,354	5,278 13
July 23rd—December 24th, 1897... ..	6,809	5,933 10
January 21st—June 30th, 1898	6,563	5,131 15
July 29th—December 24th, 1898... ..	5,977	4,910 6
January 30th—June 30th, 1899	6,818½	6,642 0
July 1st—December 30th, 1899	6,368	6,474 13

(k) THE CONSOLS REEFS.

The reefs worked by the company owning this property are portions of the Little, Middle, and Baalgammon Reefs (Plate IX). The outcrop of the Middle

Section across Consols Property.



reef lies on the eastern side of the creek bed. Its strike varies from 20° to 25° east of south. It intersects the Little Reef immediately beneath the Baker's Creek assay office.



To face page 40

CONSOLS MACHINERY AND MINE.

The diagram represents a section across the Middle and Baalgammon Reefs on the Hillgrove side of the creek. Since September last, the company have sunk the main shaft vertically from the 200 to the 300 feet level. After driving for a short distance on the Little Reef, below and beyond the creek bed, and cross cutting in a westerly direction, a fine-grained granite was met with, in which the reef died away in so-called "stringers," or ribbons of quartz. The north-west extension of the Little Reef is not so productive as the portion worked by the Baker's Creek Company. The Middle Reef yields the best stone.

Since September, 1897, this mine has yielded 3,550 oz. 12 dwt. of smelted gold, the result of crushing 4,497 tons of ore.

(l) STARLIGHT REEF.

The property containing this reef lies wholly within the coarse granite area, near the Hopetoun Mine. The workings on the reef consist of two tunnels driven in on the lode a little above the bed of Baker's Creek. The strike of the Starlight Reef approximates to an east and west direction.

The lower tunnel has been driven 230 feet into the hill, while the second and higher level has had a winze sunk on it for 60 feet. The ore body fluctuates in size, varying from a mere line to 15 inches in width.

In 1889,	7 tons 10 cwt. of stone	were crushed	for a yield of	32 oz. 11 dwt. 0 gr.
„ 1890,	47 „ 16 „	yielded ...	... ..	83 „ 14 „ 0 „
„ 1894,	9 „ 15 „	„ ...	... ..	25 „ 16 „ 0 „
„ 1895,	65 „ 15 „	„ ...	... ..	140 „ 1 „ 12 „
„ 1896,	4 „ 2 „	„ ...	... ..	11 „ 15 „ 0 „

Total...134 tons 18 cwt for 293 oz. 17 dwt. 12 gr.

Giving an average of over 2 oz of gold per ton of ore crushed.

(m) THE SANDON ELECTRIC LIGHT AND POWER COMPANY.

This company has almost completed a large dam, on the "anchor crib" weir system, near the Gara River Falls, 5 or 6 miles distant from Hillgrove. Mr. F. Cotton, M.P., is constructing this dam for the conservation of water, wherewith to drive the mine batteries, and serve the township with the electric light. The dam has an extreme length of 575 feet, a width at the base of 90 feet, tapering to 20 feet wide on top. The construction is of log-cribbing, resting on a granite foundation; the interstices in the cribbing being packed with gravel and clay. A sheet of water several miles long has been conserved. The minimum supply of water in the dam is said to be 350,000,000 gallons. One and a quarter mile of Oregon pine fluming, 2 feet deep, will conduct the water to an iron pipe 900 feet long, set at an angle of 45 degrees, thereby giving a head of 450 feet. The nozzles coming from the pipe are arranged so as to pour the water on to Pelton wheels, each the equivalent of 300 horse-power. With a loss of 20 per cent. the company expects to deliver 1,000 h.-p. to the batteries through 5 miles of wire.

This company has already lighted up the town by electricity, borrowing the Garibaldi steam-engine until such time as the dam shall be completed.

(n) PARADISE AND NO. 9 ANTIMONY LODES.

At the head of Swamp Creek, two large antimony reefs occur, about 60 feet apart, and underlaying slightly toward each other. Traced down the bluffs of the creek head (Plate III), the Paradise lode is seen to turn off at right-angles and cross the bed of the creek. Close on 2,000 tons of antimony have been extracted from these lines of reef.

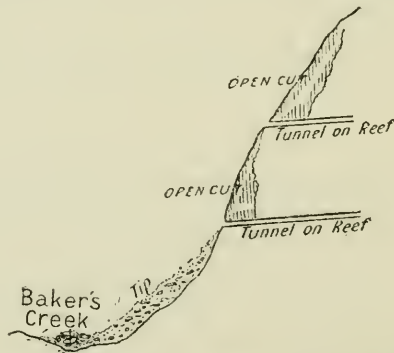
(o) MURGATROYD'S TUNNEL.

This tunnel has been driven 552 feet into the hill just below the Cooney tunnel, and on the Metz side of the gorge, at a cost of about £3,000. This includes also a cross-cut east and west from the tunnel. 188 feet from the entrance of the tunnel a tongue of crushed granite 28 feet wide was cut through, while the end of the tunnel is carried through another granite apophysis. 270 feet from the entrance a formation of yellow crushed slate occurs having a strike of south 27° east, and a dip of 80° to the north-east. It is claimed that this formation is the south-east extension of the Sunlight Reef. A winze has been sunk 30 feet in the cross-cut, and Mr. Murgatroyd intends carrying this down 200 feet. The country is much crushed and faulted.

(p) MINOR PROPERTIES.

The Baalgammon Reef.—The general trend of this vein is north 55° west, with a high general angle of dip in a north-east direction. It thus corresponds closely in strike and dip with its neighbour—the Little Reef.

Sketch illustrating method of working the Baalgammon Reef.



Above the Consols property, the Baalgammon stone has been won by a set of three tunnels driven in on the outcrop of the lode. It was pegged in by Jensen, Maddricks, and Party in 1891. Among various parcels of stone crushed were:—

18 tons of ore for a yield of	35 oz. 11 dwt. of gold.
2 " "	7 " 14 " "
3 " "	3 " 6 " "

the latter quantity being raised by tributors. This was in the upper levels. Prospectors working on a supposed lower level on the reef never met with

any payable stone. Aid was procured to cross-cut for a distance of 200 feet from the lowest tunnel; but the applicants availed themselves of the aid for 60 feet only.

Trimm's Tunnel, Mount Carrington Gold-mining Company's Tunnel, and Beiber's Tunnel have been driven into the hill to prove the continuation of certain well-known reefs. Of these, Trimm's Tunnel lies between Murgatroyd's Tunnel and the Sunlight Lode. It has been driven through the formation that crosses Murgatroyd's Tunnel, but there is nothing definite to be seen owing to intense crushing of the country. The other two tunnels were driven to pick up the southern extension of the Little Reef.

Keyes' Scheelite lies completely in the coarser granite area. It has been proved for a distance of 320 feet along the lip of the Baker's Creek Falls. It varies from 1 inch to 4 inches in width, and occurs in lenticular patches. Much of the ore won is found to contain over 60 per cent. of tungstic acid. From this lode and another but smaller one lower down the hill, 20 tons were raised during the last year.

Maddrick's Scheelite.—This property lies on the west side, and about half-way up the Baker's Creek gully. It contains some pure scheelite. Seventeen tons were raised during the last half year.

Brackin's Spur and Beck's Antimony Lode are two other localities from which considerable quantities of antimony have been raised from time to time.

DESCRIPTION OF PLATES.

Frontispiece. Panoramic view of Baker's Creek plant.

II. Whittaker's Spur, seen from the south.

III. Slate and Granite Bluff—Head of Swamp Creek.

IV. View of Baker's Creek Gorge from Campbell's Spur.

V. Eleanora plant, from the east.

VI. Sunlight Tramway. The Tramway crosses the reef.

VII. View of Sunlight Battery, with Baker's Creek Battery in middle ground, and
Cosmopolitan in distance.

VIII. Baker's Creek tramway.

IX. Consol's Battery and poppetheads.

X. Micro-photograph, taken under crossed Nicols, illustrating the faulting of
felspars in the green basic variety of granite.

XI. Section of Eleanora workings.

XII. Section of Little Reef, showing amount of stoping

XIII. Section of Big Reef, showing amount of stoping.

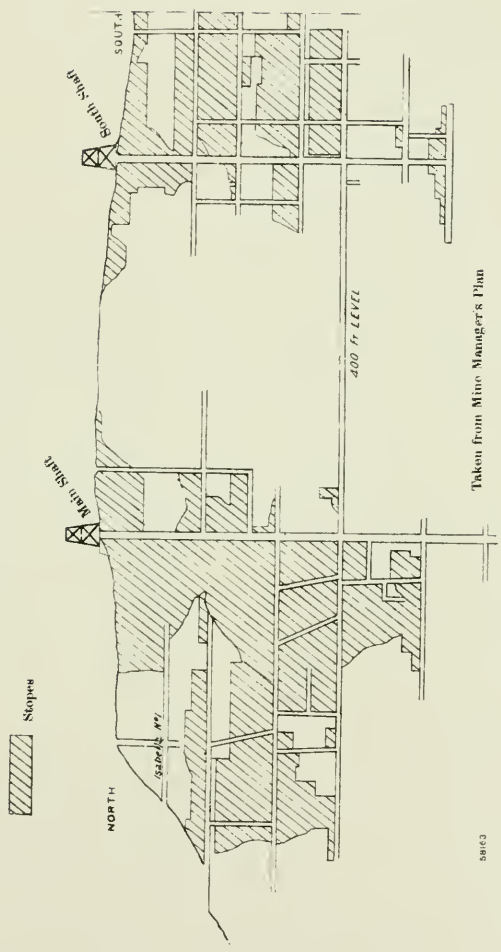
XIV. Section across Big and Little Reefs.



To face page 44.

MICROPHOTOGRAPH, ILLUSTRATING FAULTING OF FELSPARS.

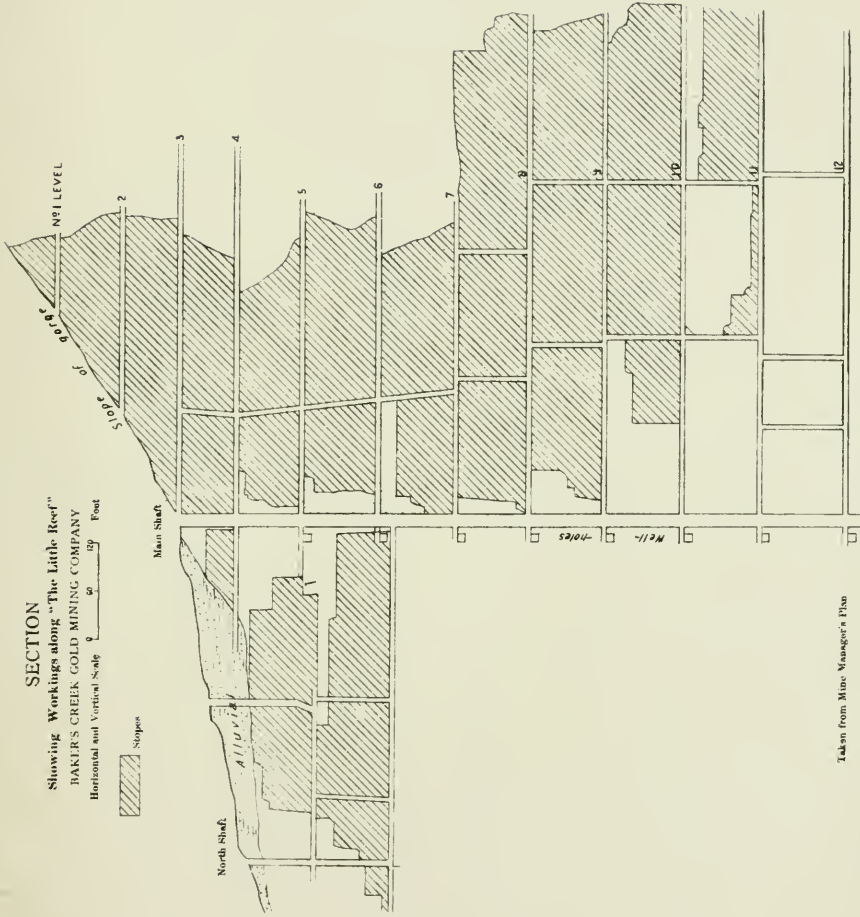
SECTION
ELEANORA GOLD AND ANTIMONY MINE
Horizontal and Vertical Scale 0 100 200 Feet



Taken from Mine Manager's Plan

58623

Photo-illustrated by
W. A. Guller, Geologist Printer,
Spring, N.S.W.



Taken from Mine Manager's Plan

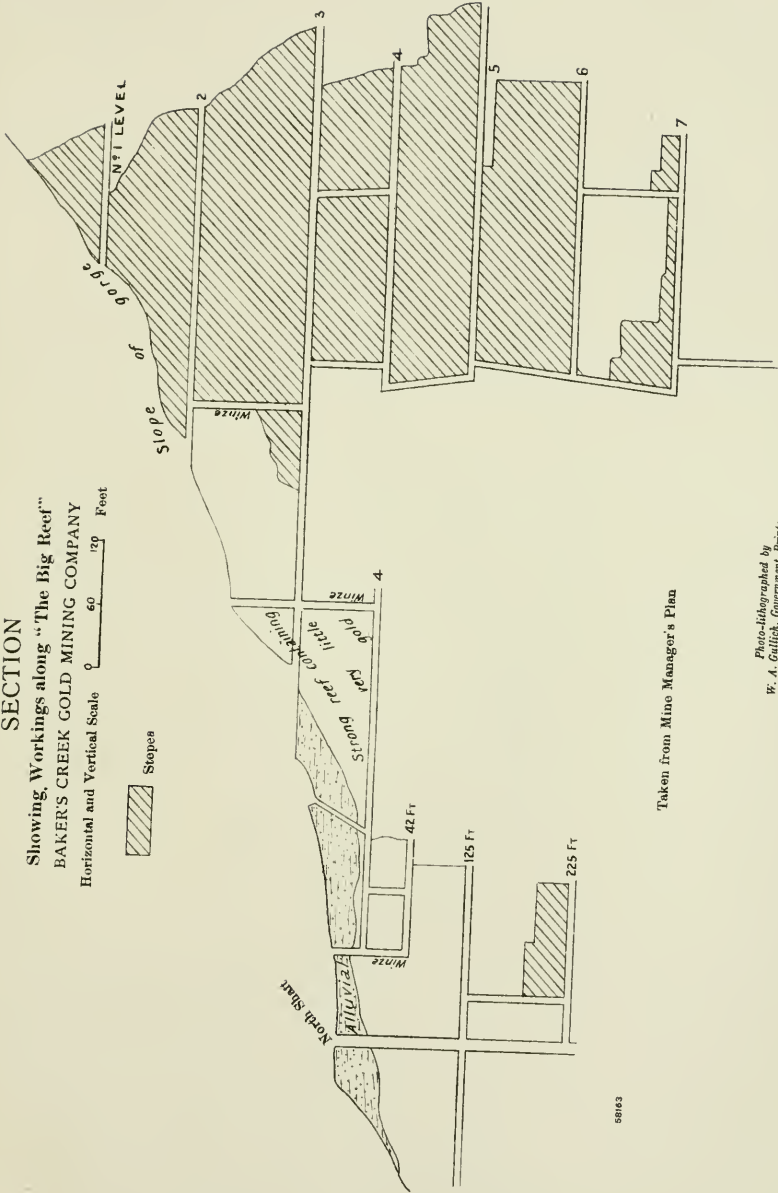
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Photo-lithographed by
 W. A. Gould, Commercial Printer,
 Spring, N.S.W.

SECTION

Showing Workings along "The Big Reef"
 BAKER'S CREEK GOLD MINING COMPANY

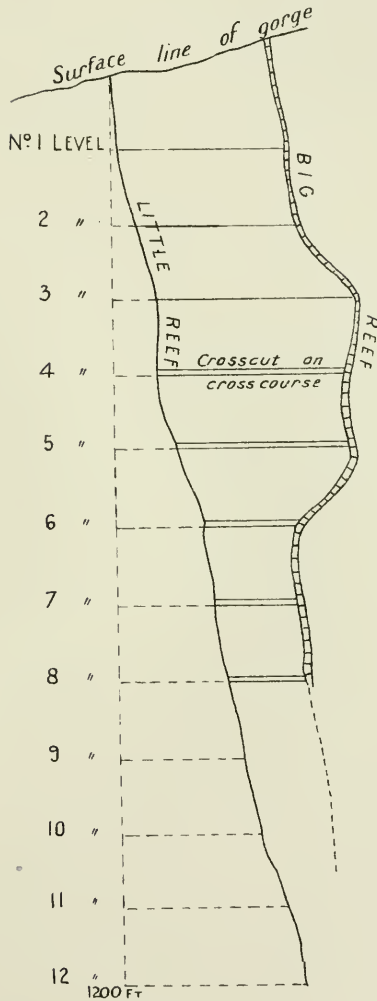
Horizontal and Vertical Scale 0 60 120 Feet



Taken from Mine Manager's Plan

Photo-lithographed by
 W. A. Gullick, Government Printer,
 Springfield, U.S.W.

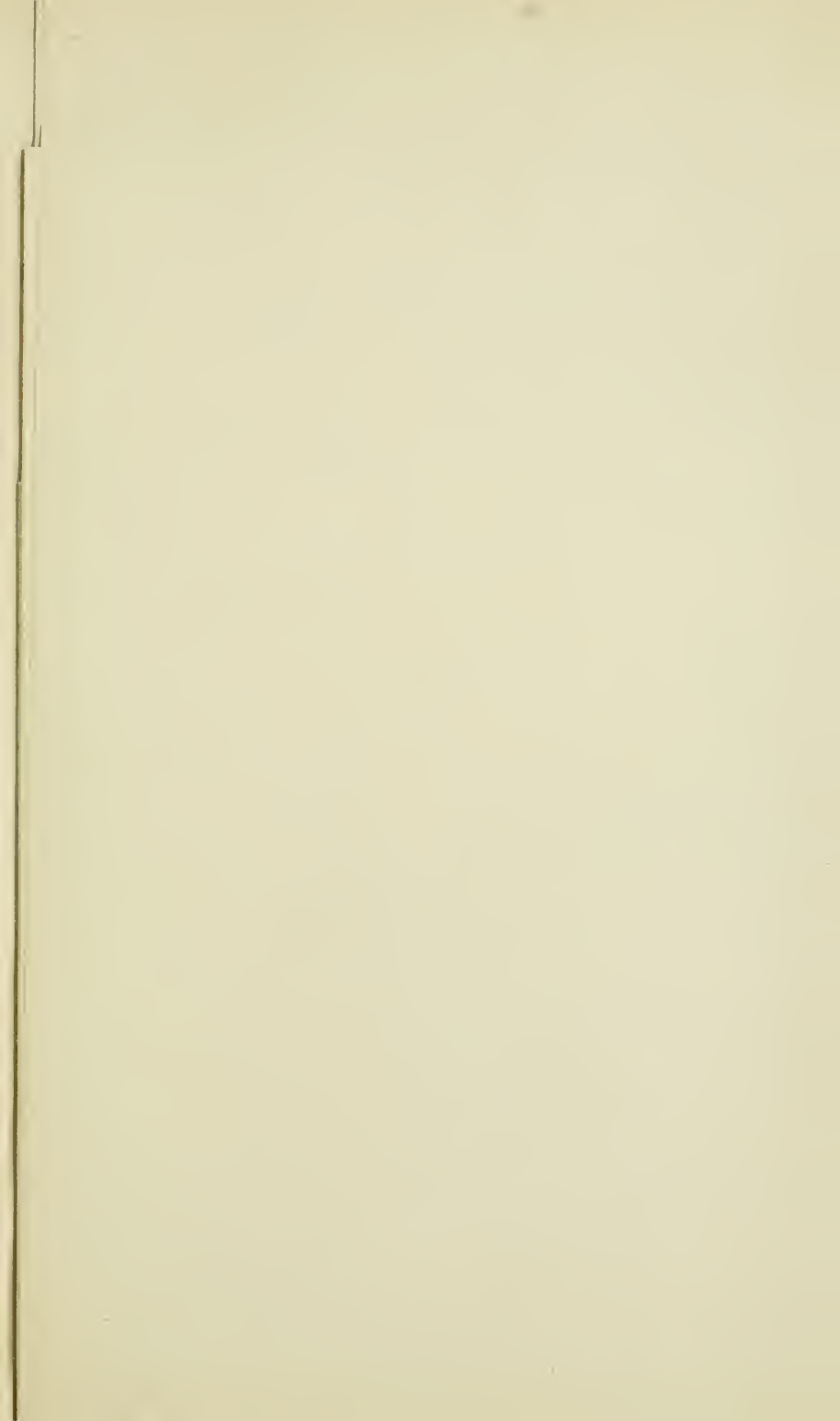
SECTION
OF THE
Big and Little Reefs
Scale 0 100 200 Feet



The main shaft is sunk on the "Little Reef" and the ore from the "Big Reef" is won by means of crosscuts driven on a crosscourse from the "Little" to the "Big Reef."

The crosscuts are projected into one vertical plane.

56163



GEOLOGICAL MAP

OF THE

HILLGROVE GOLD FIELD

OF THE

With Sections.

Commenced by J. A. WATT, M.A., B.Sc., Geological Surveyor,
completed by E. C. ANDREWS, B.A., Geological Surveyor, assisted by M. Morrison,
Field Assistant.

Prepared under the direction of E. F. PITTMAN, A.R.S.M., Government Geologist,
Department of Mines and Agriculture, Sydney, 1900.

Scale 0 10 20 30 40 Chains

REFERENCE.

SEDIMENTARY	
TERTIARY	Tertiary quartz pebble drift underlying basalt
CARBONIFEROUS (?)	Slates Quartzites Knotted and mica schists
IGNEOUS	
CARBONIFEROUS (?)	Coarse-grained Granite
	Fine-grained Granite
TERTIARY	Basalt
	Reefs and Dykes

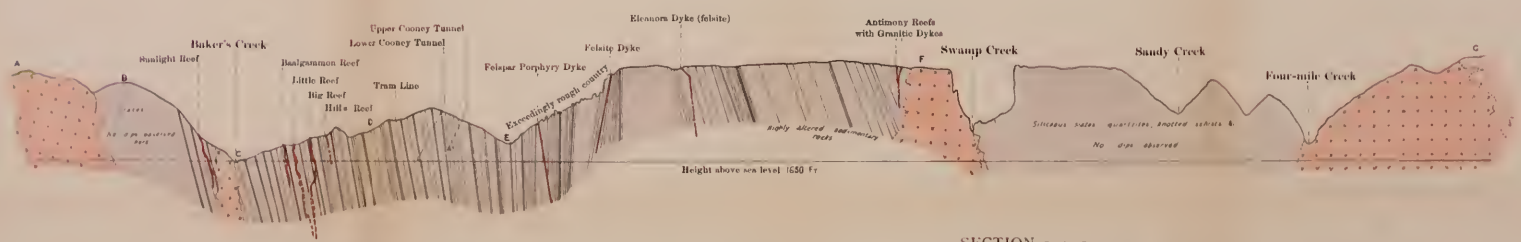


INDEX TO COMPANIES

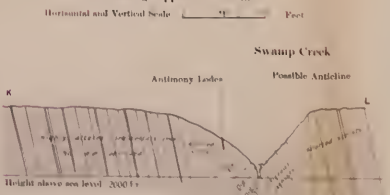
A	New England Scholten and Gold M Co
B	United G M Syndicate
C	Centennial Co
D	Eleanora Gold and Antimony Co
E	Carbald, Co
F	Roberts Creek Co
G	The Hillgrove Proprietary Mines Co
H	Roberts Creek Consols Co
I	East Cammon Co
J	West Sunlight Co
K	Sunlight Co
L	East Sunlight Co



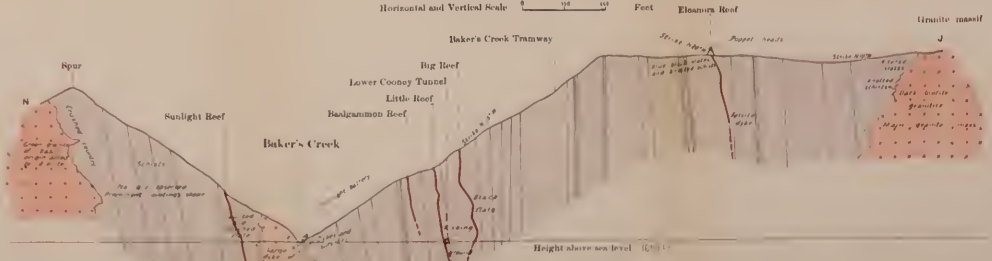
SECTION ON LINE ABCDEFG
Horizontal and Vertical Scale 0 400 800 Feet



SECTION ON LINE K L
Showing supposed anticline



SECTION ON LINE H J
Horizontal and Vertical Scale 0 400 Feet



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